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DELAWARE RIVER BASIN
TRIBUTARY TO FLAT BROOK
SUSSEX COUNTY
NEW JERSEY /

LEVEL II

SHAY LAKE DAM

NJ 00266

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

PLY REFER TO

NAPEN-N

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

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Inclosed is the Phase I Inspection Report for Shay Lake Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Shay Lake Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in fair overall condition and the spillway is considered adequate. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. However, to ensure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Retain a professional engineer qualified in the design and construction of dams to accomplish the following:

(1) Investigate the sloughing at two locations on the downstream slope, and design or specify remedial measures if needed.

(2) Design and specify repairs to the man-made "stairs" at three locations on the downstream slope to make them erosion resistant.

(3) Specify and oversee procedures for removing trees on the embankment and north abutment.

(4) Investigate the cause of the wet area near the toe of the dam and design remedial measures if needed.

(5) Specify and oversee replacement of riprap within zone of wave action on upstream face of dam.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Shay Lake Dam
Identification No.: Fed ID No. NJ00266
State Located: New Jersey
County Located: Sussex
Stream: Unnamed Tributary to Flat Brook
River Basin: Delaware
Date of Inspection: 5 November 1979

[Group 1]

ASSESSMENT OF GENERAL CONDITIONS

Shay Lake Dam is 41 years old and in fair overall condition. It is small in size and classified as Low Hazard, a downgrading from its initial classification of High Hazard. The dam embankment shows evidence of sloughing at two locations on the downstream face. Trees and brush are growing on the embankment in an area adjacent to the spillway discharge channel and north abutment. A wet area near the toe of the embankment was observed. The spillway can pass the 100-year discharge and is adequate.

It is recommended that the owner retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following in the future: design or specify and oversee repair measures for the sloughing at two locations on the downstream face; design or specify repairs to the man-made "stairs" at three locations on the downstream face to make them erosion resistant; specify and oversee procedures for removing trees on the embankment and north abutment; investigate the cause of the wet area near the toe of the dam and design remedial measures if needed; specify and oversee replacement of riprap within zone of wave action on upstream face of dam. It is further recommended that as a part of operation and maintenance procedures the owner immediately undertake a program of regularly checking the overall condition of the dam, and monitoring of the wet area near the toe of the dam. In the future the owner should: clear brush from the downstream slope in the dam; repair eroded concrete in the footbridge piers; monitor surface erosion of the concrete discharge channel and implement repairs if erosion continues; remove debris from the low-level outlet channel; exercise the low-level outlet gate and clean and paint the low-level outlet chamber cover. Also in the future, the owner should engage a professional engineer qualified in the design and construction of dams to make a comprehensive technical inspection of the dam once every two years.

ANDERSON-NICHOLS & COMPANY, INC.

Warren A. Guinan
Warren A. Guinan, P.E.

Project Manager
New Jersey No. 16848

NAPEN-N

Honorable Brendan T. Byrne

- b. Start a program of periodically checking the condition of the dam and monitoring the wet area near the toe of the dam.
- c. Clear brush on the embankment in that area adjacent to the spillway discharge channel.
- d. Repair or replace the deteriorated portions of the footbridge decking.
- e. Repair eroded concrete in the footbridge pier.
- f. Monitor surface erosion of the concrete discharge channel floor and implement repairs if erosion continues.
- g. Remove the debris from the low-level outlet channel.
- h. Periodically operate the low-level outlet gate.
- i. Clean the surface and paint the low-level outlet chamber covers.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

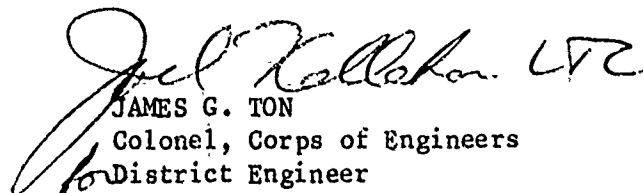
NAPEN-N

Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl
As stated


JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

SHAY LAKE DAM (NJ00266)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 5 November 1979 by Anderson-Nichols & Company, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Shay Lake Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in fair overall condition and the spillway is considered adequate. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. However, to ensure the continued functioning of the dam and its impoundment, the following remedial actions could be undertaken by the owner:

a. Retain a professional engineer qualified in the design and construction of dams to accomplish the following:

(1) Investigate the sloughing at two locations on the downstream slope, and design or specify remedial measures if needed.

(2) Design and specify repairs to the man-made "stairs" at three locations on the downstream slope to make them erosion resistant.

(3) Specify and oversee procedures for removing trees on the embankment and north abutment.

(4) Investigate the cause of the wet area near the toe of the dam and design remedial measures if needed.

(5) Specify and oversee replacement of riprap within zone of wave action on upstream face of dam.

b. Start a program of periodically checking the condition of the dam and monitoring the wet area near the toe of the dam.

c. Clear brush on the embankment in that area adjacent to the spillway discharge channel.

d. Repair or replace the deteriorated portions of the footbridge decking.

e. Repair eroded concrete in the footbridge pier.

f. Monitor surface erosion of the concrete discharge channel floor and implement repairs if erosion continues.

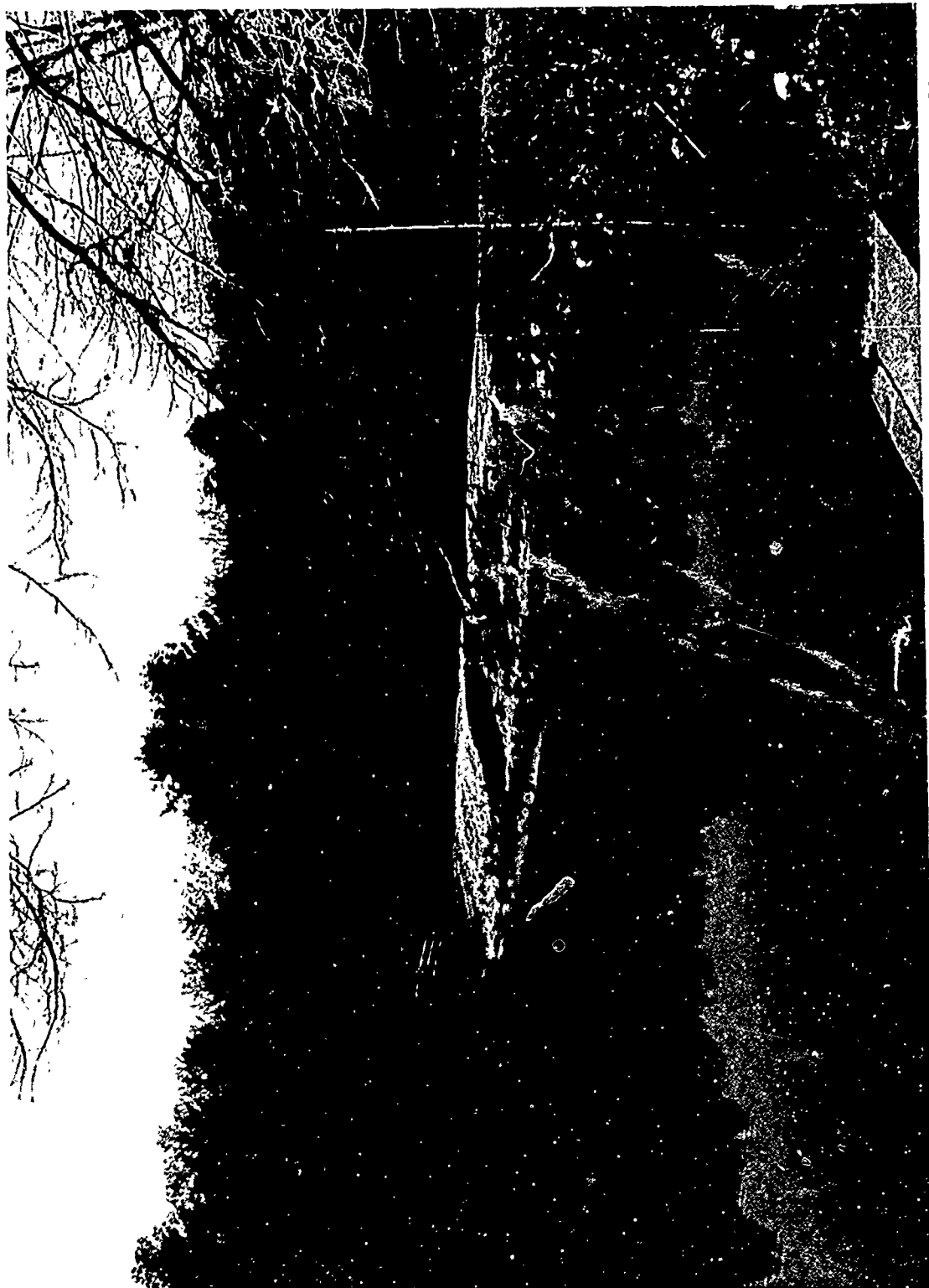
- g. Remove the debris from the low-level outlet channel.
- h. Periodically operate the low-level outlet gate.
- i. Clean the surface and paint the low-level outlet chamber covers.

APPROVED: James G. Ton

JAMES G. TON

Colonel, Corps of Engineers
District Engineer

DATE: 30 Apr 80



5 NOVEMBER 1979

OVERVIEW
SHAY LAKE DAM

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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NATIONAL DAM SAFETY REPORT
SHAY LAKE DAM
FED ID NO. NJ00266 NJ NO. 304

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
SHAY LAKE DAM
FED ID NO. NJ00266 NJ NO. 304

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Shay Lake Dam (also known as Lake Shawanni Dam) was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 26 October 1979 under Contract FPM No. 39 dated 28 June 1979. This authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 5 November 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Shay Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Shay Lake Dam is a 24 foot high, 475 foot long earthfill, clay core embankment dam built in 1938. The upstream and downstream faces are of earth and rock facing. The upstream face is inclined at 3H:1V and the downstream face is inclined at 2.5H:1V. The dam embankment top width is 12 feet. The 35-foot long free overflow stepped spillway is adjacent to the south abutment. A wooden footbridge supported by two piers spans the spillway. The spillway is of mortared stone masonry and drops in two 24-inch steps. The spillway discharge channel is a paved inclined channel with mortared masonry training walls and is approximately 75 feet long. A 24-inch diameter cast iron low-level outlet pipe passes through the toe of the dam about 160 feet from the south abutment. Access to the low-level gate mechanism is through a pair of steel doors on the crest of the dam. Essential features of the dam are given in Figure 1.

b. Location. The dam is located in Stokes State Forest in Sandyston, Sussex County, New Jersey on an unnamed tributary to Flat Brook in the Delaware River watershed. It is at north latitude 41° 10.1' and west longitude 74° 5.1.7'. A location map is given in Figure 2.

c. Size Classification. Based on its storage of 94 acre-feet, which is less than 1000 acre-feet, but more than 50 acre-feet, and its height of 24 feet, which is less than 40 feet, Shay Lake Dam is classified as small in size, in accordance with the criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Visual inspection of the downstream area revealed no structures. There is no downstream hazard. Accordingly, Shay Lake is classified as low hazard.

e. Ownership. The dam is in Stokes State Forest and owned by the State of New Jersey. Mr. Louis Cherepy, Superintendent of Stokes State Forest explained that the dam and lake is leased, free of charge, to Rutgers University for a 4-H camp. Mr. Kenneth Zimmerman, New Jersey 4-H Camp, R.D. #2, Box 44L, Branchville, New Jersey 07826 is one of the current camp directors.

f. Purpose of Dam. Shay Lake Dam was originally designed and constructed, and currently is used for recreation.

g. Design and Construction History. The dam was built by the Civilian Conservation Corps in 1937-1938. A set of plans consisting of four sheets was recovered from NJDEP files. Design specifications accompany these plans which are included in Appendix 1.

h. Normal Operational Procedures. Data received through conservation with Kenneth Zimmerman, Camp Director, New Jersey 4-H Camp indicated that the low-level outlet has been operated at irregular intervals. Mr. Zimmerman noted that the lake was last drained in 1967. No formal written operating procedures were found.

i. Site Geology. The logs of seven borings taken along the centerline of the dam are shown on a drawing dated May 23, 1938 (Sheet 2 of 4 in Appendix 4). The logs indicate that the foundation consists of "clay, sand and stones" with occasional reference to "gravel and large stones". These soil conditions are consistent with the Geological Map of New Jersey which indicates that the soils within the immediate site area consist of ground moraine overlying bedrock. Bedrock was reported for only one of the borings. This was the boring taken closest to the south abutment in which "red sandstone" was encountered at a depth of about six feet. The other six borings did not encounter bedrock and penetrated to depths of seventeen feet or less. The Geological Map of New Jersey indicates that the bedrock of the immediate site area consists of "hard sandstone" and "soft shale" of Siberian age.

1.3 Pertinent Data

a. Drainage Area

0.7 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Low-level outlet at pool elevation (at spillway crest) - 70

Total spillway capacity at maximum pool elevation (at top of dam) -- 999

c. Elevation (ft. above NGVD)

Top of dam - 829.7

Maximum pool - design surcharge (100-yr. peak inflow) - 826.2

Spillway crest - 825.0

Downstream invert low-level outlet - 807.0+

Streambed at centerline of dam - 807.0+

Maximum tailwater (approximate) - 811+

d. Reservoir (feet)

Length of maximum pool - 1000 (estimated)

Length of recreation pool - 990

e. Storage (acre-feet)

Recreation pool - 64

Design surcharge (100-yr. peak inflow) - 72

Top of dam - 94

f. Reservoir Surface (acres)

Top of dam - 8.6

Spillway crest - 8.3

g. Dam

Type - selected earthfill with clay core wall

Length - 475 feet

Height - 24 feet

Top width - 12 feet

Side slopes - upstream 3H:1V, downstream 2.5H:1V

Zoning - selected fill formed in successive 8-inch layers

Impervious core - clay core wall approximately 10 feet at toe of dam tapering to approximately 2.5 feet at dam crest

Grout curtain - unknown

h. Spillway

Type - free overflow stepped mortared stone

Length of weir - 35'

Crest of elevation - 825.0

Gates - none

Upstream channel - Shay Lake (Lake Shawanni)

Downstream channel - unnamed tributary to Flat Brook

i. Regulating Outlets

1-24" low-level outlet shown on original design plans

Valving mechanism access through steel doors on dam crest.

SECTION 2 ENGINEERING DATA

2.1 Design

A copy of the original design plans and specifications for the spillway, dam, low-level outlet and core wall dated May 1938 were recovered from NJDEP files. The design plans consist of four sheets. The plans show (1) plan of the proposed lake, (2) cross sections of the proposed dam, (3) relocation of the spillway channel, and (4) plan and sections of the spillway channel. These plans were drawn for the State of New Jersey, Department of Conservation and Development, USDA, CCC in May 1938. The specifications dated 25 May 1938 describe "The construction of an earth dam with concrete and clay core wall, stone riprap on a portion of the upstream face and stone fill at the toe of the downstream face and stone fill at the toe of the downstream slope, a cast iron pipe blowoff (low-level outlet) encased in reinforced concrete..., a masonry and rock spillway dam with a spillway channel with paved bottom and slopes."

2.2 Construction

Recorded data on file with NJDEP revealed that the dam was constructed over a period of approximately one year from 1938-1939 by the Civilian Conservation Corps. The specifications describe the methods of construction of Shay Lake Dam including construction materials, excavation, construction of the embankment and core wall, placement of riprap and placement of the low-level outlet. "Embankments and clay core wall shall be formed in successive, horizontal layers not exceeding eight inches in thickness. The layers shall be spread across the entire width of the portion of the dam between the core wall and slopes by means of a bulldozer or by hand. Each layer shall be thoroughly compacted by means of the sheepsfoot roller before the application of the next layer.... The stone fill at the toe of the dam shall be made with stones separated from the fill of the dam or with field stones brought in from adjoining areas."

2.3 Operation

No written operational data were disclosed. Communication with the current Camp Director, Mr. Kenneth Zimmerman, revealed that the low-level outlet mechanism is operated, though at irregular intervals and that the lake was last drained in 1967.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files and contact with current Camp Director revealed a substantial amount of information. All available information was retrieved.

b. Adequacy. The information retrieved concerning the design and construction of the dam is satisfactory.

c. Validity. The validity of the information retrieved was substantiated by visual inspection.

SECTION 3 VISUAL INSPECTION

3.1 Findings

a. Dam. Minor slumping of the downstream slope appears to have occurred at two locations (225 and 285 feet north of the north edge of the spillway). There are man-made "stairs" at three locations of the downstream slope (160, 175 and 225 feet north of the north edge of the spillway). The "risers" of these "stairs" consist of badly deteriorated timbers, and the "treads" consist of soil which appears to be a disintegrated shale. Little or no vegetation was noted on the stairs. One minor wet area (with no standing water) about 20 feet downstream of the toe of the dam and 75 feet north of the north edge of the spillway was observed. Remnants of a boulder riprap on the upstream slope of the dam at the waterline was noted but it is in poor condition. Some erosion of the upstream slope at and above the waterline has occurred near the right abutment. Some trees and one small clump of brush are growing on the right abutment. Brush is growing on the downstream slope of the dam between the spillway and the area to 185 feet north of it. Some small trees are growing in the area downstream of the toe of the dam near the spillway.

b. Appurtenant Structures. The surface of the concrete spillway discharge channel has eroded exposing some of the coarse aggregate. The concrete piers of the footbridge are eroded and undermining at the waterline. The wooden deck of the footbridge is surface worn and weathered. Some of the planks are deteriorated. The discharge end of the low-level outlet was not visible at the time of the inspection.

c. Reservoir Area. The watershed above the reservoir is moderately sloping and heavily wooded. Slopes adjacent to the lake appear to be stable. A New Jersey 4-H camp is located on the north shore of the lake.

d. Downstream Channel. Some brush is growing in the discharge channel downstream from the spillway, and many trees overhang the channel. A beaver dam a short distance downstream from the dam was observed. It impounds water back to the lower end of the spillway chute.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed. Normal operating procedures were described in Section 2.3.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were revealed. From the condition of the dam and appurtenant structures it is apparent that a maintenance program is followed, though no written procedures exist.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were revealed. The low-level outlet is operated at irregular intervals.

4.4 Warning System

No description of any warning system was disclosed.

4.5 Evaluation of Operational Adequacy

A regular operational and maintenance program should be established for Shay Lake Dam. This program should include measures described in Section 7.2 c. and be implemented as prescribed.

SECTION 5 HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features.

a. Design Data. Because no original hydrologic design data were available an evaluation could not be performed.

b. Experience Data. Data received through conversation with Kenneth Zimmerman, Camp Director, New Jersey 4-H Camp indicated that in the time he has lived near Shay Lake, he has never seen the dam overtopped. No written experience data were produced indicating an overtopping problem in the past.

c. Visual Observations. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection, approximately 0.2 foot of water was flowing over the spillway crest.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Shay Lake is based on a Spillway Design Flood (SDF) equal to the 100-year flood in accordance with the range of test floods given in the evaluation guidelines for dams classified as low hazard and small in size. The 100-year discharge has been determined by Stephen J. Stankowski's method as outlined in "Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization", Special Report #38, 1974. Hydrologic computations are given in Appendix C. The 100-year discharge for the subject watershed is 128 cfs. The spillway can pass the 100-year flood without overtopping the dam embankment and is considered adequate.

e. Drawdown Capability. If the low-level outlet currently in place is fully operable and free of debris it is estimated that the pond can be drained in approximately 0.7 day, assuming no significant inflow. This time period is considered adequate for draining the reservoir in an emergency situation.

SECTION 6 STRUCTURAL STABILITY

6.1 Visual Observations

Apparent sloughing at two locations on the downstream slope of the dam may be evidence that the overall stability of the downstream slope is marginal. Manmade "stairs" at three locations on the downstream slope have little or no vegetation and are consequently susceptible to erosion which could endanger the embankment especially if the dam should be overtopped. A beaver dam downstream of the dam has backed water up toward the toe of the dam. Any seepage which might be taking place now or which might develop in the future in the area where water is impounded by the beaver dam would not likely be visible during inspection of the dam. One wet area near the downstream toe of the dam may be evidence of a seepage problem, which if not controlled, could lead to instability of the dam. If trees which are growing on the right abutment should blow over and pull out their roots, or if they should die and their roots rot, serious seepage and erosion problems could result.

6.2 Design and Construction Data

Original design plans and specifications dated 1937-1938 indicate that the existing cross-section of the dam consists principally of "selected material to give a homogeneous structure having low permeability" and an upstream slope of "loose stone (to the flowline) and placed stone to the top of the dam". A clay core wall is shown along the center of the embankment. "The fill for the core wall shall have a clay content from 15% to 25%."

6.3 Operating Records

No operating records pertinent to the stability of the dam are available.

6.4 Post-Construction Changes

No word of post-construction changes pertinent to the stability of the dam are available.

6.5 Seismic Stability

Shay Lake Dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins exist." None of the visual observations made during the inspection are indicative of unstable slopes. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam, it is not possible to make an engineering evaluation of the stability of the slopes or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Shay Lake Dam is 41 years old and is in fair condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based on the results of the visual inspection and inspection of the original design drawings and specifications.

c. Urgency. The recommendations made in 7.2 a. and 7.2 c. should be implemented by the owner as prescribed below.

d. Necessity for Additional Data Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2 a. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain a professional engineer qualified in the design and construction of dams to accomplish the following in the future.

(1) Investigate the sloughing at two locations on the downstream slope, and design or specify remedial measures if needed.

(2) Design or specify repairs to the man-made "stairs" at three locations on the downstream slope to make them erosion resistant.

(3) Specify and oversee procedures for removing trees on the embankment and north abutment.

(4) Investigate the cause of the wet area near the toe of the dam and design remedial measures if needed.

(5) Specify and oversee replacement of riprap within zone of wave action on upstream face of dam.

b. Alternatives.

None

c. Operating and Maintenance Procedures. The owner should do the following soon:

(1) Start a program of periodically checking the condition of the dam and monitoring the wet area near the toe of the dam.

The owner should do the following in the near future:

(1) Clear brush on the embankment in that area adjacent to the spillway discharge channel.

(2) Repair or replace deteriorated portion of footbridge decking.

The owner should do the following in the future:

(1) Engage a professional engineer qualified in the design and construction of dams to make a comprehensive technical inspection of the dam once every two years.

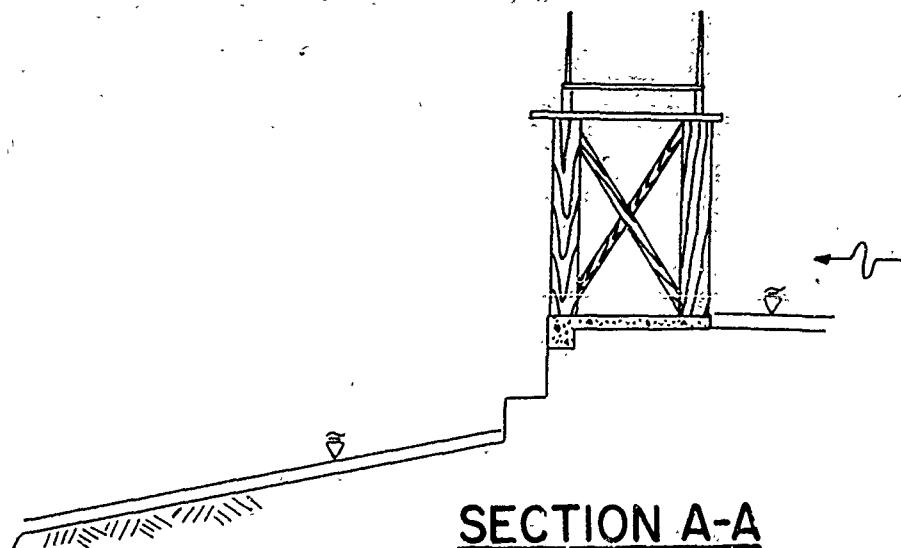
(2) Repair eroded concrete in the footbridge pier.

(3) Monitor surface erosion of the concrete discharge channel floor and implement repairs if erosion continues.

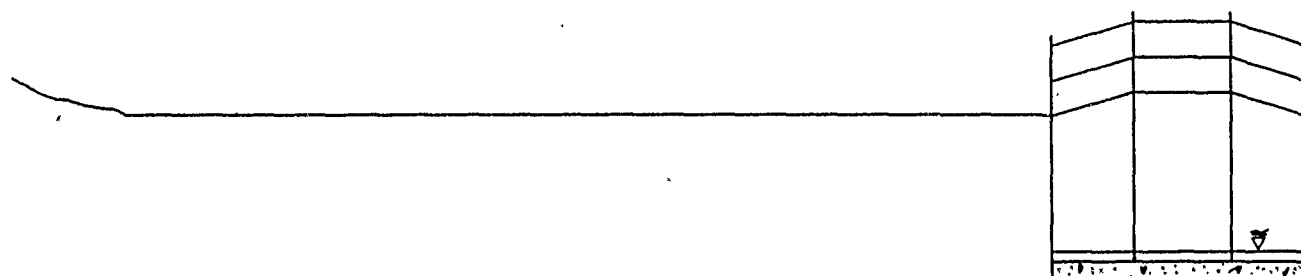
(4) Remove the debris from the low-level outlet channel.

(5) Periodically operate the low-level outlet gate.

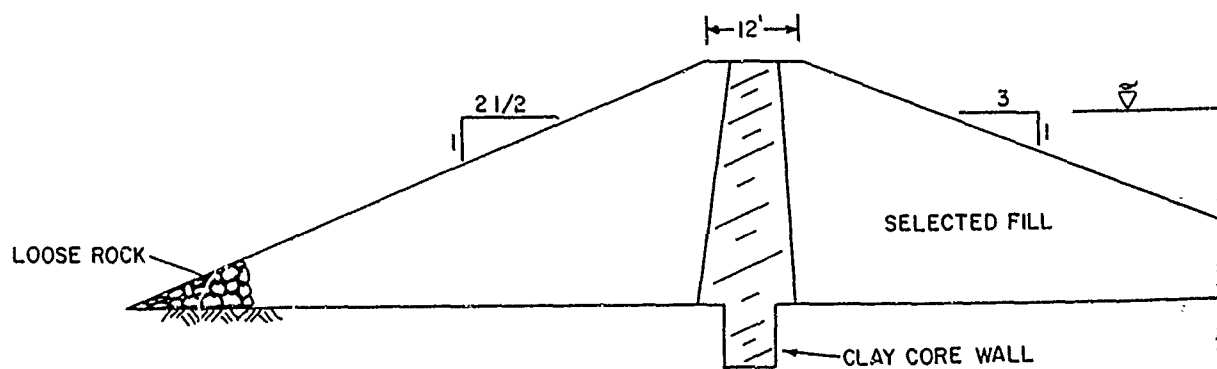
(6) Clean the surface and paint the low-level outlet chamber covers.



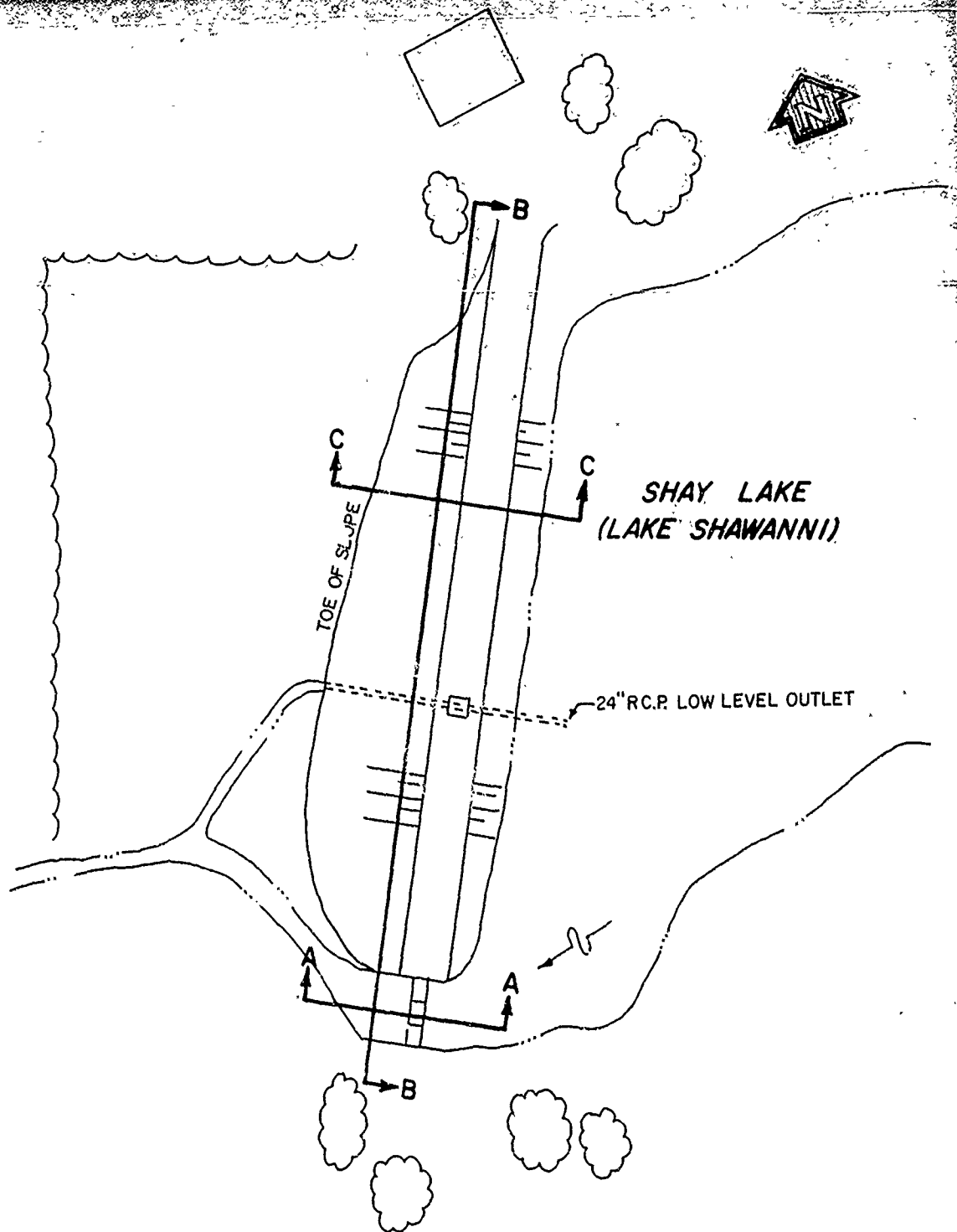
SECTION A-A



ELEVATION B-B



SECTION C-C

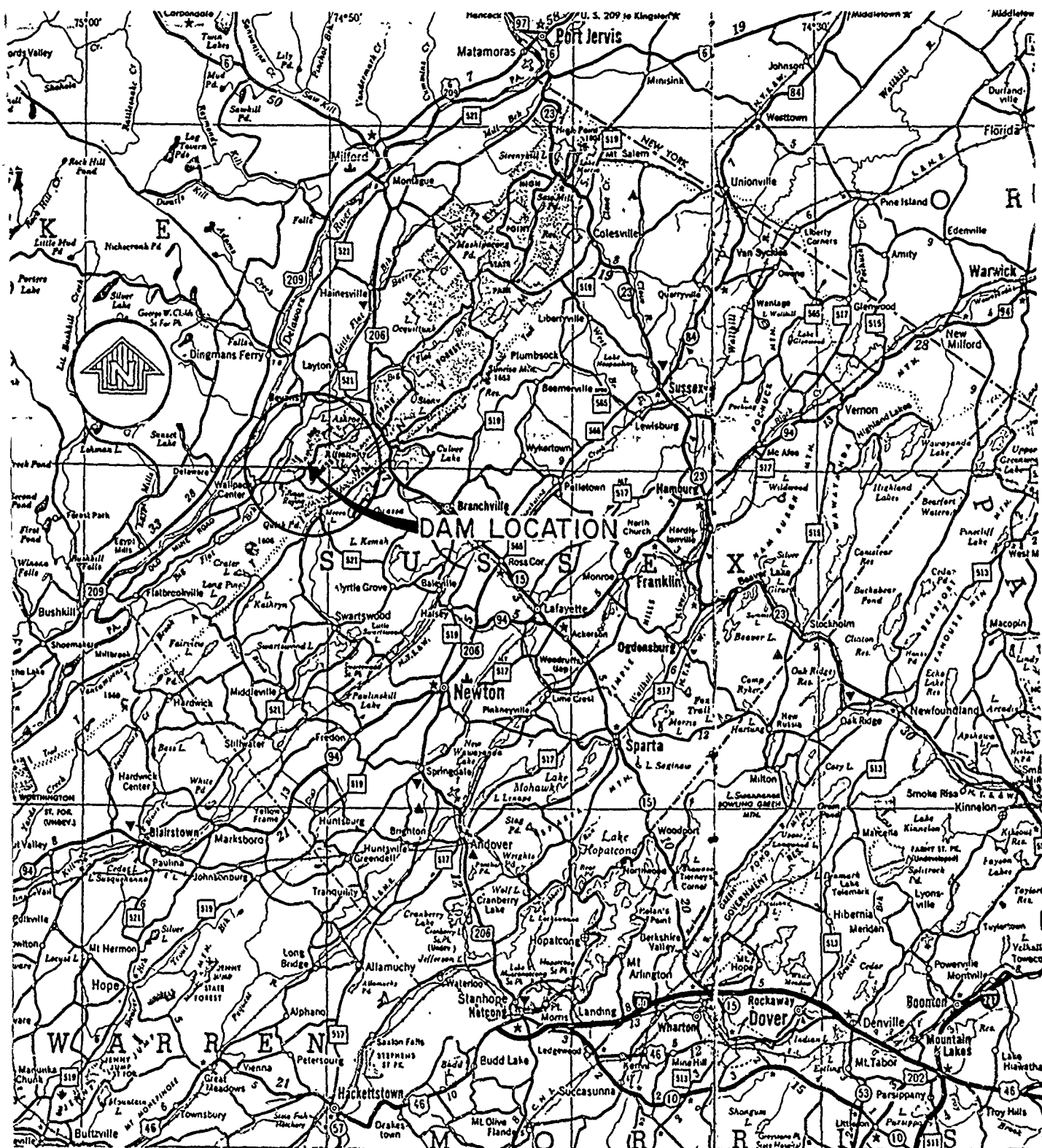


DATA FROM DESIGN PLANS 28 MAY 1938 AS SHOWN IN APPENDIX 4 AND
FIELD INSPECTION 5 NOVEMBER 1979

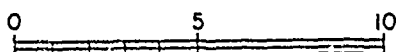
Anderson-Nichols & Co., Inc		U.S. ARMY ENGINEER DIST. PHILADELPHIA	
CONCORD		CORPS OF ENGINEERS	
NEW HAMPSHIRE		PHILADELPHIA, PA.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
SHAY LAKE DAM			
TRIBUTARY TO FLAT BROOK		NEW JERSEY	
		SCALE: NOT TO SCALE	
		DATE: JANUARY 1980	

2

FIGURE 1



SCALE IN MILES



MAP BASED ON STATE OF NEW JERSEY
OFFICIAL HIGHWAY MAP AND GUIDE.

Anderson-Nichols & Co., Inc.

CONCORD

NEW HAMPSHIRE

U.S. ARMY ENGINEER DIST. PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SHAY LAKE DAM LOCATION MAP

TRIBUTARY TO FLAT BROOK

NEW JERSEY

SCALE: SEE BAR SCALE

C

APPENDIX I
VISUAL INSPECTION
CHECKLIST

SHAY LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Shay Lake Dam County Sussex State New Jersey Coordinators NJDEP
Date(s) Inspection Nov. 5, 1979 Weather sunny, cool Temperature 30°
Pool Elevation at Time of Inspection 825.2 MSL Tailwater at Time of Inspection 807.5 MSL

Inspection Personnel:

Warren Guinan

Stephen Gilman

Kenneth Stuart

Ronald Hirschfeld

Gilman and Hirschfeld Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some erosion of three "stairs" on downstream slope formed by placing short logs as "risers". Minor sloughing of downstream slope at one other location.	Remove log "risers," repair eroded stairs, and re-establish vegetation. Repair slough area and re-establish vegetation
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment is good. Crest has a somewhat uneven surface with a maximum vertical amplitude of not more than a few inches.	No action required
RIPRAP FAILURES	Some boulders on upstream slope at waterline appear to be remnants of riprap. Minor erosion at waterline.	Riprap should be repaired within zone affected by wave action.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None observed	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition	
ANY NOTICEABLE SEEPAGE	None observed.. One minor wet area (no flowing water) 20 ft downstream of toe of dam	Monitor wet area. If conditions worsen, evaluate need for remedial measures.
STAFF GAGE AND RECORDER	None observed	
DRAINS	None observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not visible	
INTAKE STRUCTURE	Steel plate cover surface rusted	Clean and paint
OUTLET PIPE	Not visible	
OUTLET CHANNEL		
EMERGENCY GATE	Not visible	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER	None observed	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently sloping. Mostly tree covered. No evidence of instability observed	
SEDIMENTATION	No evidence of significant sedimentation observed.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	Stone masonry mortared weir in good condition. Stone masonry mortared training walls in good condition.	No action required.
APPROACH CHANNEL	Good condition. No obstructions. No trees overhanging channel.	
DISCHARGE APRON	Good condition. Trees overhanging channel.	Clear trees from bank of discharge apron for a distance of 25 feet on either side of apron to eliminate possibility of spillway blockage by fallen trees.
BRIDGE AND PIERS OVER SPILLWAY	One foot wide concrete piers for foot bridge are set on the spillway and are showing erosion at water surface. The footbridge is made of wooden posts, beams and planks. The wooden planks are in fair condition. Posts and beams are in good condition.	Repair erosion of concrete. Repair deteriorated planks.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Many trees overhanging channel, brush growing in channel immediately downstream of spillway discharge apron. Beaver dam downstream of discharge apron.	Clear trees and brush from discharge channel and banks of discharge channel for a distance of 25 feet on either side of channel to eliminate possibility of spillway blockage and for some distance downstream of dam to allow for identification of seepage problems. Remove beaver dam to eliminate possible backwater problems at toe of dam.

SLOPES

Steep and wooded.

APPROXIMATE NO. OF HOMES AND POPULATION

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plans for this report were developed from visual inspection 5 Nov. 1979 and a set of original design plans by the Civilian Conservation Corps. date 1938-39.
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	Records retrieved from NJDEP revealed design plans and specifications from the CCC 1938-1939
TYPICAL SECTIONS OF DAM	Sections of dam were developed from visual inspection 5 Nov. 1979 and a set of original design plans by CCC 1938-1939.
HYDROLOGIC/HYDRAULIC DATA	No original data was disclosed
OUTLETS - PLAN	From CCC 1938-1939 design plans
- DETAILS	From CCC 1938-1939 design plans
- CONSTRAINTS	none disclosed
- DISCHARGE RATINGS	none disclosed
RAINFALL/RESERVOIR RECORDS	none disclosed

ITEM

REMARKS

DESIGN REPORTS

Original design plans and specification from CCC 1938-1939

GEOLOGY REPORTS

None disclosed

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES

None disclosed

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

Boring information shown on design plans (sheet #2).
Foundation materials discussed in design specifications.

POST-CONSTRUCTION SURVEYS OF DAM

None disclosed

BORROW SOURCES

Unknown

ITEM	REMARKS
MONITORING SERVICES	Unknown
MODIFICATIONS	None disclosed
HIGH POOL RECORDS	None disclosed
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None disclosed
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed
MAINTENANCE OPERATION RECORDS	None disclosed

ITEM

REMARKS

SPILLWAY PLAN

SECTIONS

DETAILS

Plans and sections for this report were developed from visual inspection 5 Nov. 1979 and a set of original design plans by the CCC dated 1938-1939

OPERATING EQUIPMENT

1 - 24' cast iron low level outlet

PLANS & DETAILS

Plans and sections for this report were developed from visual inspection 5 Nov. 1979 and a set of original design plans by the CCC dated 1938-1939

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

C DRAINAGE AREA CHARACTERISTICS: 0.7 Sq. miles moderately sloping and heavily wooded
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 825.0 (NGVD) 64 acre-feet
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 829.7 (NGVD) 94 acre-feet
ELEVATION MAXIMUM DESIGN POOL: 826.2 (NGVD) (from peak inflow)
ELEVATION TOP DAM: 829.7 (NGVD)

CREST: free overflow stepped spillway

- a. Elevation 825.0 (NGVD)
- b. Type mortared masonry
- c. Width 35 feet
- d. Length 2.5 feet
- e. Location Spillover adjacent to south abutment
- f. Number and Type of Gates none

OUTLET WORKS: low level outlet

- a. Type 24 inch cast iron
- b. Location 160 feet north of south abutment
- c. Entrance Inverts unknown
- d. Exit Inverts 807.0+
- e. Emergency Draindown Facilities 24 inch cast iron last operated 1967

HYDROMETEOROLOGICAL GAGES: None

- a. Type _____
- b. Location _____
- c. Records _____

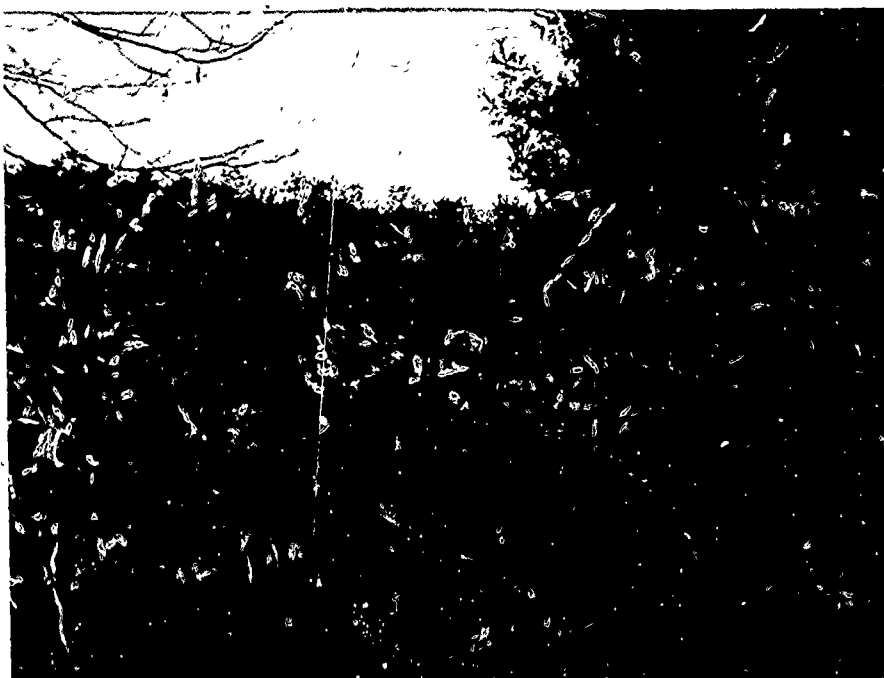
MAXIMUM NON-DAMAGING DISCHARGE: 999 CFS

C

APPENDIX 2

PHOTOGRAPHS

SHAY LAKE DAM



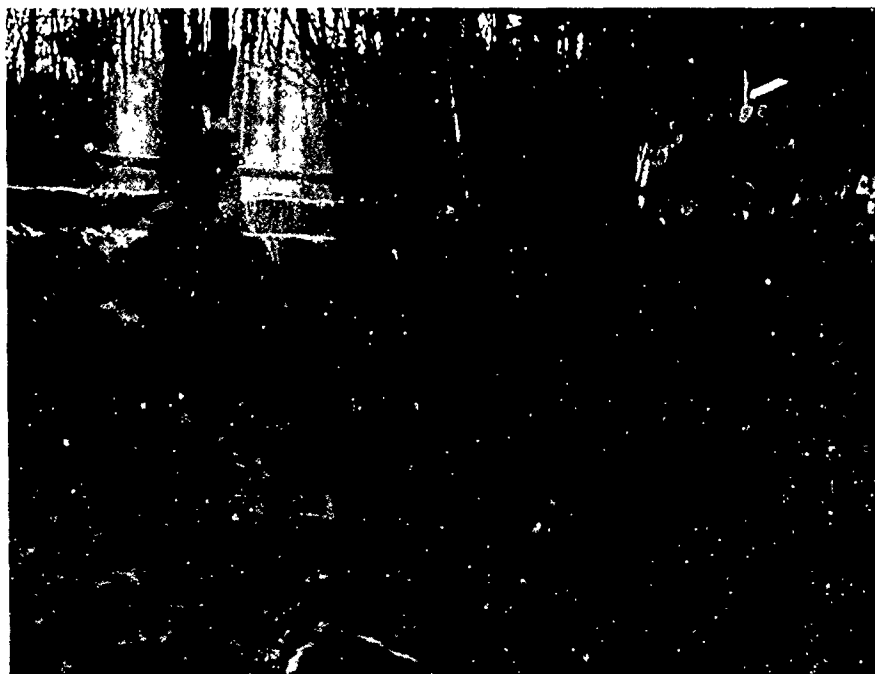
5 NOVEMBER 1979
View from north abutment looking along dam
crest.



5 NOVEMBER 1979
View from south abutment looking along dam
crest.



5 NOVEMBER 1979
View from south edge of lake looking at spillway
and wooden footbridge over spillway.



5 NOVEMBER 1979
View from spillway training wall showing stepped,
free overflow spillway and piers for wooden
footbridge.



5 NOVEMBER 1979
View of spillway discharge channel.

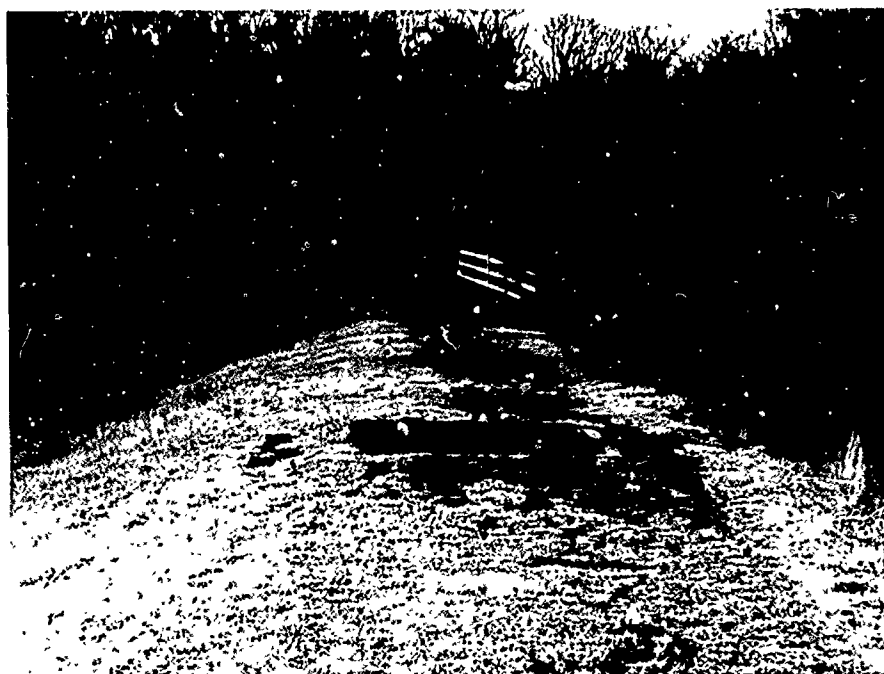


5 NOVEMBER 1979
Upstream face of dam embankment.

SHAY LAKE DAM



5 NOVEMBER 1979
Downstream face of dam embankment. Note clump
of trees adjacent to north side of spillway
discharge channel.



5 NOVEMBER 1979
View from the center of the dam embankment looking
south showing access to the low-level outlet valving
mechanism in the foreground and the wooden footbridge
in the background.



5 NOVEMBER 1979
View showing clump of trees and brush adjacent
to discharge channel.



5 NOVEMBER 1979
View from wooden footbridge over spillway looking
upstream at Shay Lake.

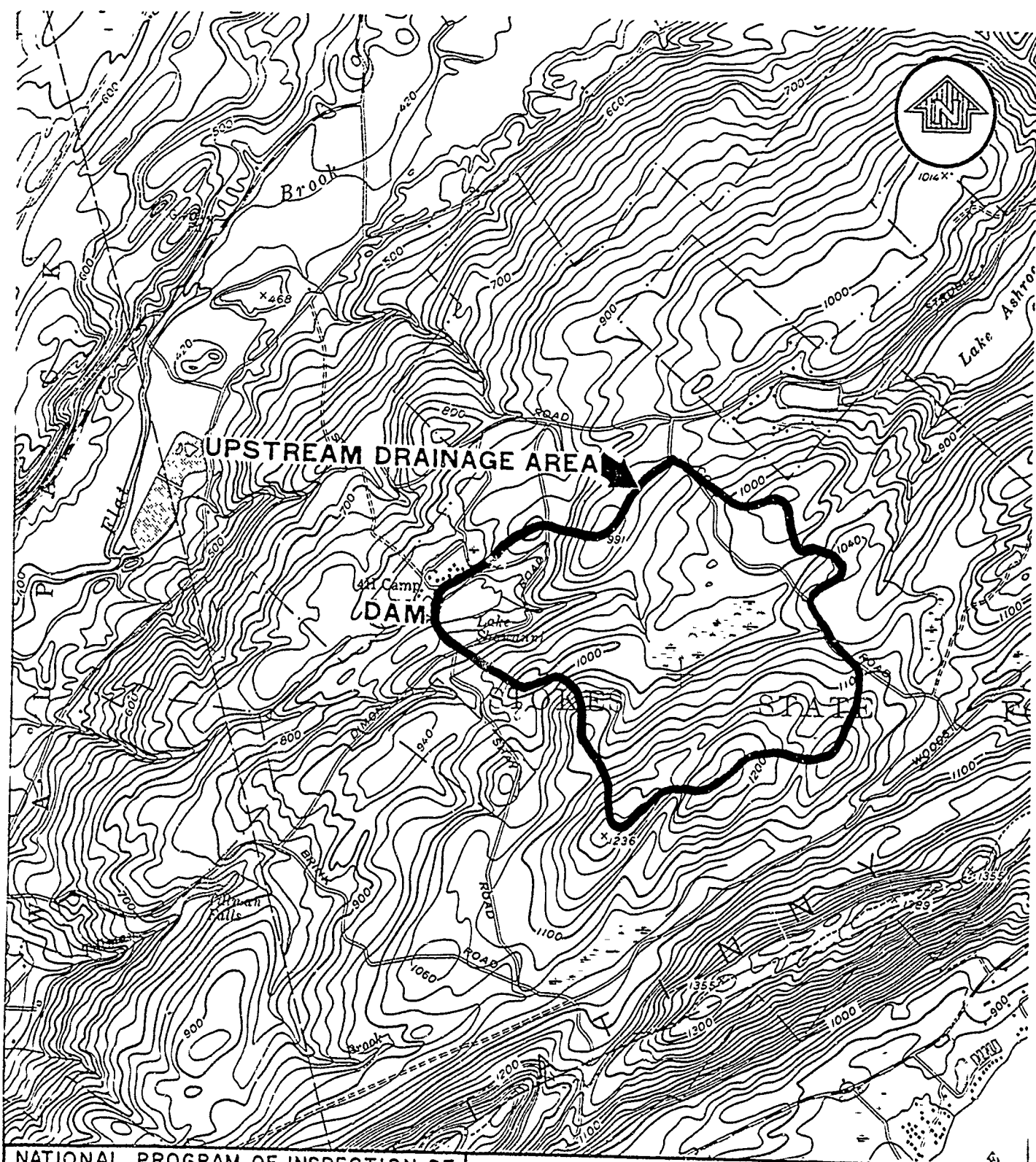


5 NOVEMBER 1979
View from wooden footbridge looking downstream
at spillway discharge channel.

C

APPENDIX 3
HYDROLOGIC COMPUTATIONS

SHAY LAKE DAM



NATIONAL PROGRAM OF INSPECTION OF
NON-FED. DAMS

SHAY LAKE DAM

SANDYSTON, NEW JERSEY

REGIONAL VICINITY MAP

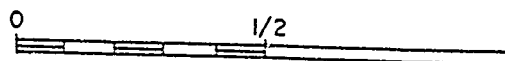
JANUARY 1980

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC.

CONCORD, N.H.

SCALE IN MILES



MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE
SHEET. CULVERS GAP, N.J., PA. 1954. REVISED 1971.

Anderson-Nichols & Company, Inc.

Subject H2H

Sheet No. 1 of 6
Date 11/79
Computed RJB
Checked CF DD

JOB NO. 3409-11

SHAY LAKE DAM

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

HYDROLOGIC COMPUTATIONS

NAME: SHAY LAKE DAM

LOCATION: SUSSEX COUNTY, NJ

DRAINAGE AREA: 0.7 SQUARE MILES

SURFACE AREA AT NORMAL POOL: 8.3 ACRES

EVALUATION CRITERIA : SIZE: SMALL
HAZARD: LOW

Anderson-Nichols & Company, Inc.

Subject

H&H

Sheet No. 2 of 6

Date 11/79

Computed HJS

Checked FDD

JOB NO. 3409-11

SHAY LAKE DAM

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

ELEVATION VS. DISCHARGE

ELEVATION	SPILLWAY		DAM			TOTAL
	H	Q	H	L	Q	Q
825.0	0	0				0
825.5	0.5	35				35
826.0	1.0	98				98
826.5	1.5	180				180
827.0	2.0	277				272
827.5	2.5	387				387
828.0	3.0	509				509
828.5	3.5	642				642
829.0	4.0	784				784
829.5	4.5	936				936
829.7	4.7	999	0	0	0	999
830.0	5.0	1096	1.3	100	39	1135
832.0	5.5	1815	2.3	450	3767	5582
834.0	6.0	2646	4.3	490	10486	13132

"C" VALUES: SPILLWAY = 2.8, DAM = 2.4, "L" LENGTH: SPILLWAY = 35'

Anderson-Nichols & Company, Inc.

Subject H&HSheet No. 3 of 6
Date 11/74
Computed KJS
Checked _____JOB NO. 3409-11SHAY LAKE DAMSQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

A VISUAL INSPECTION OF THE AREA DOWNSTREAM OF SHAY LAKE DAM REVEALED NO STRUCTURES ALONG THE DISCHARGE CHANNEL, THOSE STRUCTURES INDICATED ON THE U.S.G.S. MAP WERE FOUND NOT TO EXIST. THERE IS NO DOWNSTREAM HAZARD. SHAY LAKE DAM IS, THEREFORE, CLASSIFIED AS A LOW HAZARD. AS DIRECTED BY COE, PHILADELPHIA, THOSE DAMS WITH A LOW HAZARD MAY USE A 100 YEAR DISCHARGE OR 50 YEAR DISCHARGE TO DETERMINE THE SPILLWAY ADEQUACY. THE 100 YEAR DISCHARGE IS DEVELOPED USING THE STANKOWSKI FORMULA. IF THE SPILLWAY'S CAPACITY EXCEEDS THIS 100 YEAR DISCHARGE, FURTHER ANALYSIS IS UNNECESSARY.

JOB NO. 3409-11

SHAY LAKE DAM

SQUARES
1/4 IN. SCALE

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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DEVELOPMENT OF 100 YEAR DISCHARGE

$$Q_{100} = .136 A^{0.84} b^{0.26} S_t^{-0.51} I^{0.09}$$

WHERE A = DRAINAGE AREA IN SQUARE MILES

b = MAIN-CHANNEL SLOPE IN FEET PER MILE

 S_t = SURFACE STORAGE INDEX

I = INDEX OF MANMADE IMPERVIOUS COVER

AND A = 0.7 SQ. MI.

b = 223

 $S_t = 5.7 + 1.0 = 6.7$

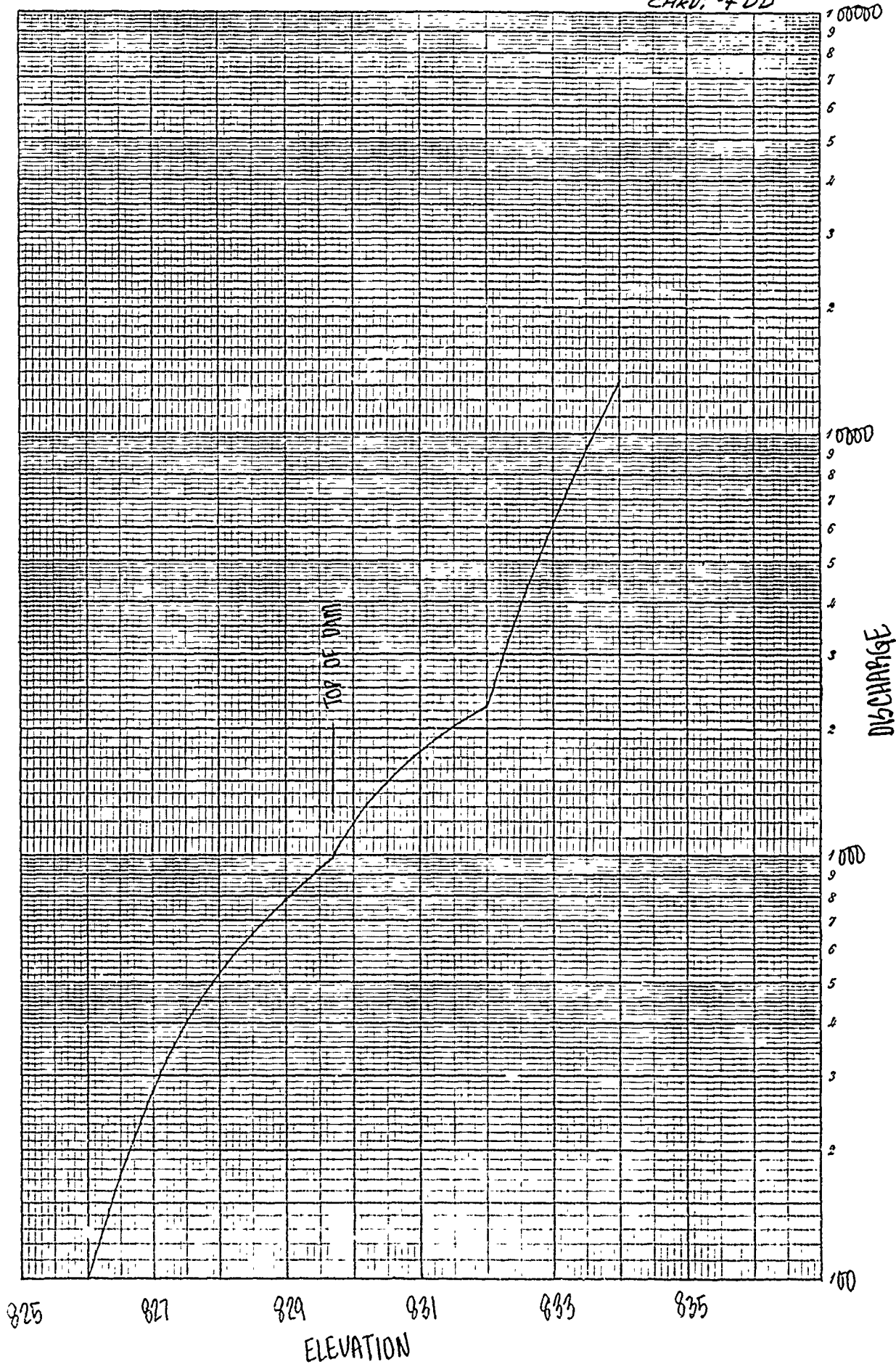
I = .117

$$Q_{100} = 128 \text{ cfs}$$

SPILLWAY CAPACITY IS 999 CFS AT TOP OF DAM THEREFORE

THE SPILLWAY CAN PASS THE 100 YEAR FLOOD.

LAKE SHAWANNI
 RATING CURVE
 COMPUTED: KJB 5/16
 CHKD: FDD



SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
1/4 IN. SCALE

DRAWDOWN CALCULATIONS

CALCULATIONS ASSUME ① NO SIGNIFICANT INFLOW ② ONE 24"

C.I. PIPE (LOW LEVEL OUTLET) TO BE FULLY OPERABLE ③ $Q_p = C_p(H)^{1/2}$ ④ ACRE-FEET/DAY = 1.9835 (AVG. Q) ⑤ DAYS = Δ STORAGE / ACRE-FT/DAY

ELEVATION	STORAGE ACRE-FT	Δ STOR. ACRE-FT	H FT.	Q CFs	AVG. Q	ACRE-FT/ DAY	DAYS
825	64		20	70			
		10			69	137	0.07
823	54		18	67			
		9			65	129	0.07
821	45		16	63			
		9			61	121	0.07
819	36		14	59			
		8			57	113	0.07
817	28		12	54			
		6			52	103	0.06
815	22		10	50			
		6			47	93	0.06
813	16		8	44			
		5			41	81	0.06
811	11		6	38			
		4			35	69	0.06
809	7		4	32			
		4			27	54	0.07
807	3		2	22			
		3			11	22	0.14
805	0		0	0			

TOTAL = 0.73 DAY

$$Q_p = C_p(H^{1/2}), \quad C_p = A_p \sqrt{\frac{2g}{1 + K_L + K_F L_p}} \quad C_p = 15.7$$

SHAY LAKE TOTAL CAPACITY = 21 MILL GAL. FROM DAM APPLICATION 7 JUNE 1938

C

APPENDIX 4
ENGINEERING DATA

SHAY LAKE DAM

depth so that the underlying ground shall be as nearly impervious to the seepage of water as possible and suitable as a foundation upon which to start the fill. The imperviousness and suitability of the site after excavation to be determined by Federal or State inspection, and to be approved by them before starting the fill.

Care shall be taken in this operation that no pockets are created in which water may stand so as to cause grade saturation and drainage by means of ditches, or pumping if necessary, shall be provided.

Any top-soil or soil suitable for the growth of vegetation shall be removed from the site of the excavation and stored so as to be used on the surface of the downstream slope for the growth of grass or other vegetation to prevent erosion.

Any materials removed in excavation such as sand, clay or stone suitable for fill on the slopes or in the downstream fill of the dam or stone toe shall also be preserved and stored for use, or directly deposited if possible.

Excavation for Structures

Excavation for the structures shall only be made to the necessary dimensions for the construction of that structure. Care shall be taken that excavation for slopes and grades shall be to the exact line of that slope or grade so that it will not be necessary to make fills on slopes or grades. Any slopes or grade disturbed in the removal of stumps and roots shall be refilled with suitable material, thoroughly tamped and recut on slope or grade lines after consolidation and left in a neat and trimmed condition.

All slopes and grades shall be protected during construction and any slopes or grades not covered by the structure shall be cleaned of all loose stones, foreign material, roots of trees, etc. and all portions which have settled, or are not to the proper slope or have been washed out, shall be brought to a smooth uniform surface.

The excavation for the care-wall, spillway and cut-off walls, if the soil and water conditions permit, shall be excavated to the bottom of the structures so that the masonry or concrete can be deposited or cast in place without sheetpiling, shoring or forms. Otherwise the excavation shall be to sufficient width only to permit the proper installation of sheetpiling, shoring and forms.

The bottom of the care-wall and spillway excavation shall be carried to the necessary depth to obtain impervious and stable conditions, to be approved by Federal or State authorities, and shall be leveled, drained and grouted if necessary before placing the concrete or masonry. Any loose or soft material that may develop in the bottom of the trench through rains or other causes, after the approval by Federal or State inspection, shall be removed before placing the concrete or masonry.

Any top-soil or materials suitable for fill removed in these operations shall be preserved and disposed of as described above.

The excavation for the spillway dam will be in ledge rock and should be to neat lines as is possible to obtain particularly the lip of the spillway dam.

Blasting shall only be done by competent and trained men and in strict accordance with the CCC Safety Regulations covering this class of work.

Borrow Excavation

Borrow pits, furnishing suitable material for fill in the dam may be established in the vicinity of the dam provided excavation from such pits, if located within the limits of the proposed lake, does not decrease the imperviousness of the bottom of the lake against seepage or percolation or if without the limits of the proposed lake such excavation does not interfere with the scenic features or damage the forest, such locations to be approved by Federal or State Inspectors, the Landscape Architect and Forest Supervisor.

The banks of all borrow pits shall be cut to a natural slope, the bottom of the pit left level, all trees, stumps and other debris disposed of and the area left in a neat and as natural a condition comparable to the original condition as possible, planting or the starting of vegetation being done if required by the Landscape Architect or Forest Supervisor.

EMBANKMENT AND CORE-WALL

The fill for the core-wall and the dam on the upstream side of the core-wall shall be selected material to give a homogeneous structure having low permeability. The fill for the core-wall shall have a clay content from 15% to 25%. Such material shall be free from loose stones having a greater diameter than 2 inches, and from vegetation, roots, debris or other foreign substances that might deteriorate or injure the imperviousness and stability of the embankment. After the borrow pits are located from which it is determined by visual examination in test pits that material having the above characteristics can be obtained, samples of such material shall be subjected to field laboratory tests to determine the grading and for compaction characteristics as determined by the Proctor test.

The selected material shall also be tested in the Larnaghi compression test apparatus to determine the tendency of the material to expand after compaction under changed loading conditions or moisture content.

The area of the dam excavation before any fill is placed shall be levelled and rolled with a sheepfoot roller. Any holes that may have been made during the excavation shall be filled in layers and compacted as hereinafter described.

Embankments and clay core-wall shall be formed in successive, horizontal layers not exceeding eight (8) inches in thickness. The layers

RECEIVED

MAY 25 1964

STATE POLICE

DAM APPLICATION NO.

RECEIVED

FOR

FILE

OK

5/20

7/4/68

STATE POLICE

FILE

Specifications for the construction of an earth dam with concrete and clay core-wall, stone rip-rap on a portion of the upstream face and stone fill at the toe of the downstream slope; a cast-iron pipe blow-off or drain pipe encased in reinforced concrete with concrete supports and cut-off collars, with trash screen and gate chamber; a masonry and rock spillway dam with a spillway channel with paved bottom and slopes.

MATERIALS

All materials used shall be the best of their respective kinds. Native materials that meet the specifications and tests hereinafter described and the inspection of Federal and State authorities shall be used.

All purchased materials shall meet the requirements of the standard government contracts and specifications or any special specifications deemed advisable for that particular material.

LABOR

All labor shall be performed by members of the Civilian Conservation Corps or such skilled labor as may be deemed necessary and hired under government regulations acting under the instructions and supervision of the technical service of the Civilian Conservation Corps.

EXCAVATION

Clearing and Grubbing

All trees, stumps, roots and other objectionable materials within the limits of the structures shall be removed from the site of the work and disposed of in a satisfactory manner. All holes and depressions caused by such operations which may extend beyond the limits of the structure and not removed or obliterated in the completion of the structure shall be filled with selected and suitable material and be thoroughly tamped.

Due care shall be taken in performing the foregoing described work that only the trees and other objectionable material that actually interfere with the prosecution of the construction, or the scenic effects after construction shall be removed and then only under the instruction and advice of the Landscape Architect.

Excavation for Dam

The area covered by the dam shall be excavated to the necessary

shall be spread across the entire width of the portion of the dam between the core-wall and the slopes by means of a bulldozer or by hand. Each layer shall be thoroughly compacted by means of the sheepsfoot roller before the application of the next layer. Wetting will be required where necessary to accomplish a thorough compacting of the fill. The degree of compaction and proper moisture content of the fill shall be determined by the Proctor test and by the oven drying test, as the work progresses and the degree of sprinkling and rolling and the thickness of the layers varied to give the best results.

Embankment and core-wall fill shall not be formed by filling to varying heights and permitting the material to flow down the face of the fill to lower elevations.

The stone fill at the toe of the dam shall be made with stones separated from the fill of the dam or with field stones brought in from adjoining areas.

CONCRETE

Composition

Concrete shall be composed of Portland cement, sand and trap rock or pebbles mixed by volume in the proportions of approximately 1:2:4, the exact proportions to be determined by tests when the sand and stone have been selected.

Cement

The cement shall be a standard brand of Portland cement guaranteed to meet Federal Specifications SS-C-191.

Sand

The sand shall be composed of grains or particles of quartz or other hard and durable rocks, moderately sharp, free from soft, decomposed or partly decomposed sand grains, lumps of clay, or ferruginous cemented mica, loam, sea salts, organic matter or other foreign materials.

It shall be of such sized grains that all the particles will pass a one-quarter (1/4) inch mesh screen and all be retained on a 800-mesh sieve; that no. over 20% of the material will be retained on a 10-mesh sieve; and that the intermediate size particles will be graded uniformly between the limits above described.

Coarse Aggregate

The coarse aggregate for the concrete shall either be broken stone or washed gravel. If broken stone, it shall be trap rock free from mud, loam,

clay or other foreign material and must not contain more than ten percent of stone coated or partly coated with stone dust. Where used in the spillway dam it shall be of such a size that all of it shall pass a two and one-quarter ($2\frac{1}{4}$) inch mesh screen and all be retained on a one-quarter inch ($\frac{1}{4}$ ") mesh screen. In all other structures it shall be of such a size that all of it will pass a one and one-half ($1\frac{1}{2}$) inch mesh screen and be retained on a one-quarter ($\frac{1}{4}$) inch mesh screen. The various stone fragments between these described limits composing any particular size shall be uniformly distributed throughout the mass of stone as shipped.

If of washed gravel, it shall be composed partially or totally of crushed pebbles free from soft, thin, elongated pieces, organic matter, loam, clay, or pebbles coated therewith. The pebbles shall be of a sound, hard, durable character free from weathered, decomposed pebbles, pieces of coal or other foreign material. It shall not contain more than five percent of slate, shale, or soft sand-stone particles. The gravel shall be so washed that the surface of the different pebbles are clean and free from all coating of loam or clay before the gravel is loaded into the shipping vehicle. The size shall be such that where used in the spillway dam all of the pebbles will pass a two (2) inch mesh screen and be retained on a one and one-quarter ($1\frac{1}{4}$) inch mesh screen and in all other structures all of the pebbles will pass a one and one half inch ($1\frac{1}{2}$ ") mesh screen and all be retained on a one-quarter inch ($\frac{1}{4}$ ") mesh screen. The various intermediate sizes of pebbles between these described limits composing any particular grade of gravel shall be uniformly distributed throughout the mass of gravel shipped.

Forms

Forms shall be well built, substantial, and mortar tight. Forms shall not be wired through the wall but shall be properly braced and shall conform to the dimensions shown on the plans. Forms once used shall be cleaned before used again. For exposed surfaces materials used for forms shall be sound and free from loose knots, shall be dressed to a smooth surface and shall be uniform in thickness and each plank must be of uniform width. The edges shall be accurately fitted together and secured to the studding or uprights in horizontal lines. The forms shall be treated with oil or grease before any concrete is placed therein. No concrete shall be placed in freezing weather without special permission.

Any pipes or conduits which are to be set in the walls or encased in concrete shall be placed in the forms before the concrete is deposited and shall be thoroughly cleaned before placing the concrete.

Mixing Concrete

Concrete shall be mixed in a mechanically propelled concrete mixer of the batch type. The quantity of each ingredient required to prepare a batch of concrete of the desired size shall be determined at the initial stage of the work. The quantity of water required to produce concrete of the desired consistency shall also be determined at the initial stage of construction. After a quantity thus required has been established, no changes shall be made in the measuring devices which determine the

quantity of each ingredient thus required.

Each batch must be in motion in the mixing drum at least one and one-half (1-1/2) minutes or as much longer as necessary to secure a uniform, homogeneous concrete that has the required consistency and workability. The concrete shall be mixed only in such quantities as will be required for immediate use. Any concrete that has developed initial set before being deposited in place shall not be used.

Placing Concrete

Concrete shall be placed in the forms immediately after mixing. It shall be so deposited that the aggregates are not separated. Throwing or dropping the concrete any considerable distances, depositing large quantities at any point and running or working it along the forms or any other practice to cause segregation of the ingredients will not be allowed. It shall be compacted by continual tamping and spading. Care shall be taken to fill every part of the forms, to work the coarser aggregate back from the face and to force the concrete under and around the reinforcement without displacing it. Concrete shall be deposited in continuous horizontal layers and, whenever practicable, shall be deposited continuously for each monolithic section of the work.

When concreting is to be discontinued for an indefinite period, a construction joint as shown on the plans shall be made to form a keyway. In making horizontal joints in the concrete where fresh concrete is connected with concrete which has set, the space shall be cleaned thoroughly of all laitance and foreign materials before the new concrete is placed. In vertical joints where it is desirable to make an expansion joint, the old concrete shall be cleaned and covered with two brush coats of hot liquid asphalt before the new concrete is placed in order that there shall be no adherence between the old and new concrete. Careful attention shall be given to the proper curing of the concrete and all exposed surfaces shall be protected from the sun and in drying weather shall be kept wet during the initial curing.

Removal of Forms

Forms on vertical surfaces shall not be removed within less than twenty-four hours nor more than forty-eight hours except in cold or damp weather and then not until the concrete has thoroughly set. After the forms are removed from exposed surfaces, any ridges due to cracks or joints in the forms shall be erased with wooden floats. Any openings or cavities shall be cleaned by removing all loose particles and shall be scrubbed with a wet brush and dusted with neat cement and the opening immediately filled with mortar of plastic consistency and of the same composition as used in the wall, which shall be firmly forced into the cavity or opening. When the opening is well filled, a wooden float shall be used to bring the surface of the mortar in a true plane with the surrounding surface. Plastering finished surfaces with neat cement or mortar is prohibited.

REINFORCING STEEL

All reinforcing bars shall be of the deformed type and the metal from which the bars and mesh reinforcements are made shall comply with the Federal specifications for such material.

The bars shall be of the sizes shown on the plans and the mesh reinforcement shall be 6" x 6" mesh #10 gauge electric welded reinforcing wire.

MASONRY

Stone

The stone used in the construction of stone masonry structures shall be a native, hard, durable stone that will easily permit of its being cut, chipped, or chiseled into the required shape or form. The stone used shall be in its natural shape or form, rough dressed or hand dressed.

Rough dressed stone shall be fairly rectangular in shape, having at least one smooth, even face but not less than three inches in thickness nor less than eight inches in width and having a length greater than one-half the thickness of the wall in which the stone will be used. Rough dressed stone shall be used in the faces of all exposed walls.

Hand dressed stone will be hand dressed to nearly rectangular shape. The front face shall be smooth and even, free from objectionable depressions or projections, be rectangular in shape, have straight edges with square corners, and the other sides dressed nearly perpendicular to this face. Hand dressed stone shall be not less than eighteen inches in length, six inches in thickness nor less than one foot in width. Hand dressed stone shall be used in the steps forming the down-stream slope of the spillway dam.

Header stone shall be equal in length to the thickness of the wall in which it is to be placed.

Construction

The largest stone available shall be used in the bottom course, with a gradual decrease in size towards the top. All stone shall be laid in a bed of mortar and so placed as to properly break joints so that each joint shall be 6 inches or more horizontally from the adjacent joint in the next course and bind together, be firmly anchored and embedded in the mortar so as to form a good substantial wall having a neat and finished appearance. The stones must also be laid with their bedding plane and lines of stratification in a horizontal position. Face stones shall be so laid that exposed surfaces are practically parallel with the face of the

wall and no projections extending over two inches beyond the face line of the wall. Sufficient header stone shall be used that one-fourth of the face stone is of this type and that they must be evenly distributed over the face of the wall. The stone used for the backing shall be of the same thickness as the adjacent face stone, similarly laid, and shall be firmly embedded in the cement mortar. All spaces between the stone shall be filled flush with mortar and packed with spawls thoroughly embedded in the cement mortar. Sufficient mortar shall be used to fill all openings so no voids in any part of the wall will be permitted. The stone used in the faces of walls shall be so selected that the wall will be free from disintegrated stone and have a uniform color and appearance.

Mortar

The mortar used shall be composed of one part Portland cement and three parts by volume of concrete sand hereinbefore specified. The mortar used in the faces of the walls may be mixed with a pigment to give it a color that may be required.

The joints in the face of the wall shall be raked out to the depth shown on the plan to obtain as near a natural rock face as is possible to obtain.

RIP-RAP

Riprap shall be composed of native stone approved as to size and quality and shall be laid at the places indicated on the plans. This stone shall be sound "one-man stone" free from structural defects not less than one-third of a cubic foot in volume and not less than three inches thick. The width of no stone shall be less than two and one-half times its thickness and the depth shall be as shown on the plans. The larger sizes and best quality of the native stone meeting these requirements shall be used on the up-stream face of the dam. The stone of poorer quality and smaller sizes is to be used on the slopes and bottom of channels where required.

Stone shall be bedded one against the other with the ends in contact. The spaces between the larger stones shall be filled with spawls of suitable sizes and all spawls shall be rammed thoroughly into place. Care shall be exercised in placing this stone to have the smoother side or end of the stone on the exposed surfaces so that the finished surfaces of the riprap shall present an even, tight surface true to the lines, grades, and sections given.

BLOW-OFF OR DRAINPIPE

The blow-off or drainpipe shall be composed of twenty-four inch cast iron pipe encased in reinforced concrete supported by concrete supports together with concrete cut-off walls, intake trash screen, gate-chamber, and control valve.

shall be diamond pattern, steel floor-plate, three-eighths inch thick, of the dimensions shown on the plan. It shall be hinged to a three-eighths by six inch steel strip around the opening to the gate chamber. This steel strip shall be securely fastened to the concrete by 1/2 inch by 8 inch galvanized bolts embedded in the concrete. The plate covers shall be provided with staple, hasp and a #850 Yale lock.

Gate Valve

The gate valve shall be a single gate, light pressure valve of the Ludlow Valve Mfg. Co., list #15 or equal. This gate valve shall be provided with flanged joints and with a wheel and gate stand directly connected to the valve stem.

NIR:GW
5/24/38

State of New Jersey
State Water Policy Commission
REPORT ON DAM APPLICATION

To the State Water Policy Commission,
State of New Jersey.

Gentlemen:

The application of the Department of Conservation and Development filed May 26, 1937 for approval of plans and for a permit to construct a dam known as Shay Lake at ~~near~~ Stokes State Forest on a branch of Flat Brook tributary to Flat Brook in Sussex County, New Jersey, has been examined by John H. Brooks Assistant Division Engineer.

PRINCIPAL FEATURES

Location 21.2.2.2.9 <input type="checkbox"/>	Site inspected 5/5/37 J.H.B. 1/19/38 J.H.B.
Purpose of dam Recreation in State Forest.	
Drainage area 0.7 sq. mi.	Elevation of flow line 900' ± A.M.T.
Area of lake 2.3 acres.	Capacity of lake 21 Mill. gals.
Type of dam Earth, embankment, concrete and clay core wall.	Top width 12.0 feet.
Upstream slope 3:1	Downstream slope 2-1/2:1
Length of dam (395) feet.	Max. height (17.0) feet.
Foundation material Ledge rock and hardpan.	
Type of spillway Weir in notch in ledge rock.	Length of spillway (25.0) feet.
Max. head on spillway 2.1 feet. Critical depth for 500 sec. ft.	
Spillway capacity 355 sec. ft. per sq. mi.	
Outlets other than spillway One 24" drain, C.I. pipe with gate valve in manhole.	

Four drawings approved by W. I. Risley, License No. 1941.

It has been found that the site for the dam is suitable and the plans adequate to insure the construction of a structure which will not be a menace to life or property. It is therefore recommended that the plans be approved and that a permit be issued, subject, however, to the following terms and conditions:—

1. That this permit does not give any property rights, either in real estate or material, nor any exclusive privileges; neither does it authorize any injury to private property nor invasion of private rights, nor any infringement of Federal, State or local laws or regulations; nor does it waive the obtaining of Federal assent, when necessary.

2. That the work shall at all times be subject to supervision and inspection by representatives of the State Water Policy Commission and that no changes in plans and specifications as approved shall be made except with written consent of the Commission. The Commission however, reserves the right to require such changes or modifications in the plans and specifications as may be considered necessary, and further reserves the right to suspend or revoke this permit at any time should such action be deemed advisable in the interest of public safety.

3. That the work shall be under the direction of a competent engineer, and that he or a competent representative shall be on the ground daily during the construction and until the completion of the dam.

4. That the Commission shall be notified in advance of the proposed time of the commencement of this work; that no material shall be placed on any portion of the foundation until such portion of the foundation has been approved in writing by a representative of the Commission.

5. That a report, on forms to be submitted by the Commission, on the status of the construction work shall be mailed to the State Water Policy Commission, State House Annex, Trenton, New Jersey, on the first day of each month until the work upon the dam has been completed.

6. That no brush or waste timber cleared from the area under this approval shall be burned unless and until the party doing the work shall have obtained a permit from the Firewarden of the district in which the burning is to be done, in accordance with ~~Section II, Chapter 122, P. L. 1906~~
R. S. 13: 9: 10

7. That no flashboards or other obstruction shall be placed or permitted to remain on the crest of the spillway.

8. That the work shall be started within one year from date of this permit and completed within two years from said date; otherwise, this permit, if not previously revoked or specifically extended, shall cease and be null and void.

9. This permit shall not become operative unless and until the applicant shall file with the Commission within thirty days from date hereof, upon a form furnished by the Commission, its written acceptance of the terms and conditions hereby imposed.

10. Details of spillway and spillway channel are subject to revision after excavation has disclosed precise location of ledge rock.

Best Available Copy

Trenton, New Jersey,

June 7, 1938

John N. Brooks
Assistant Division Engineer.

J. T. Cateblom
Division Engineer.

June 11, 1940.

New Jersey Department of Conservation & Development
State House Annex
Trenton, New Jersey

Re. Dam Application No. 304,
Shay Lake

Attention: Mr. W. I. Risley.

As the result of inspection by Mr. John M. Brooks, Assistant Division Engineer with this Commission, on June 7, 1940, of the upstream embankment at the Shay Lake dam in Stokes State Forest, I can advise you as follows:

In an area about 20 feet by 30 feet in size, having its upstream edge at the toe of the upstream embankment and its left edge ten feet to the right of the blow-off pipe, the embankment fill quakes under the tractor hauling the sheepsfoot roller and in this area there are two damp spots and one point (at test pipe No. 9) where water rises through a "pipe" in the fill to the surface of the fill, which at the time of inspection was about two feet thick.

The area of quaking fill is over the original stream bed where a stratum of blue clay 3 to 4 feet thick and 2 to 3 feet below the original surface was removed because it was thought that the clay would afford a poor foundation. At other points on the embankment where the clay stratum was left in place no dampness has appeared in the superimposed fill.

Your engineers have driven a number of two-inch pipes into the fill in the quaking area and at the pipes, where the clay is still in place, the clay was found to be just as hard as the fill and the underlying material.

Examination of a hand sample of the blue clay shows it to be hard when dry and becoming very sticky but not fluid when wet.

Water was encountered in the trench for core wall down the slope of the right bank. This water has now been diverted from its former course down the valley, by the core wall, and a small spring has developed upstream from the dam on the right bank.

Our conclusions are that the blue clay strata furnish a satisfactory foundation, that the quaking of a small area of the upstream embankment indicates that a uniformly plastic fill is being obtained and that the upstream embankment may safely be completed in accordance with the approved drawing, which calls for a 3:1 slope.

As an added safeguard against possible slipping of the upstream fill, we suggest that the rock blanket at the toe of the upstream embankment be made two feet thicker than shown on the approved drawing.

Yours very truly,

H. T. C.
B

H. T. Critchlow,
Engineer in Charge.

JNH: MFB

H-T-C Authorized signature
C-11-40

2/20

APPENDIX 5

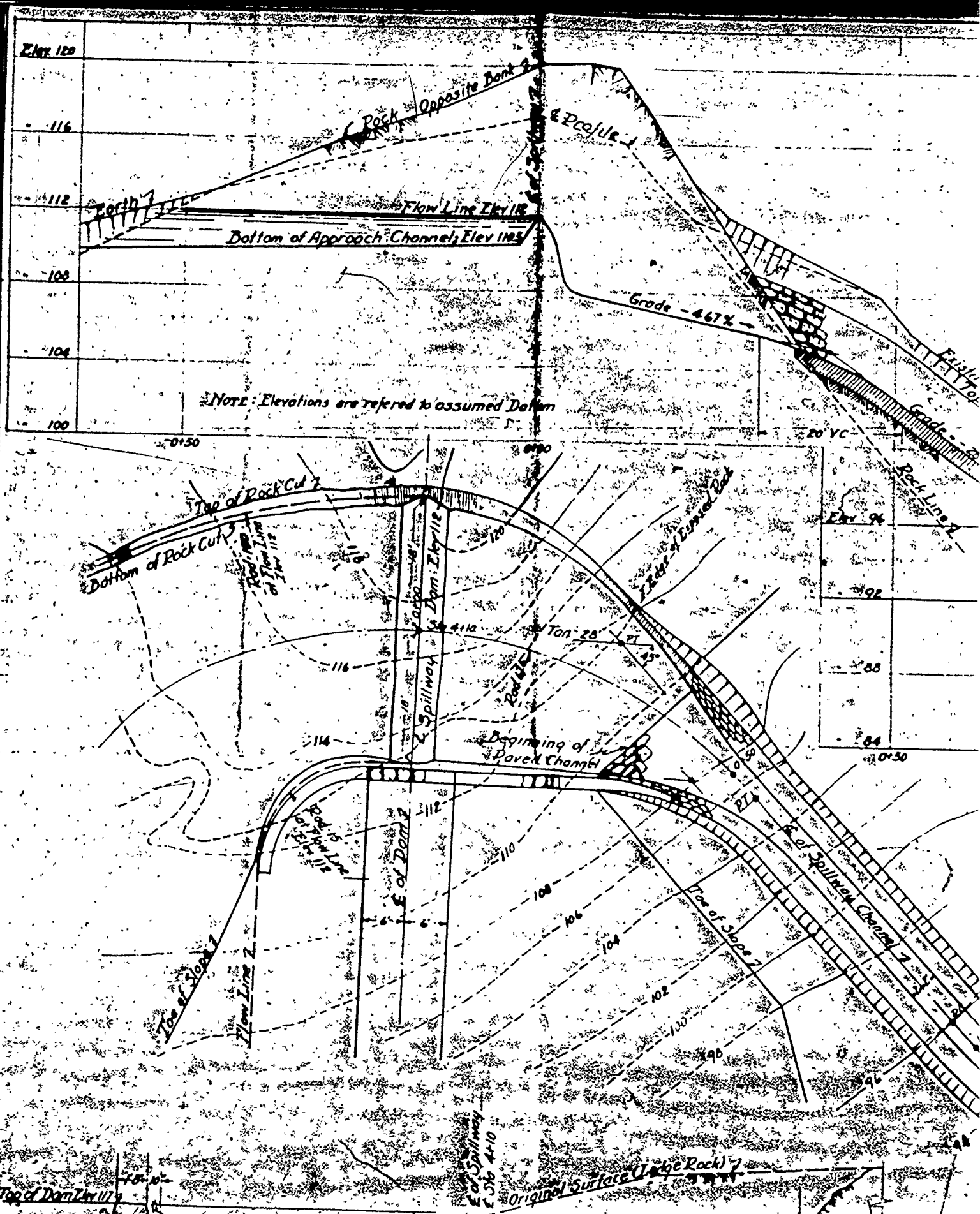
REFERENCES

SHAY LAKE DAM

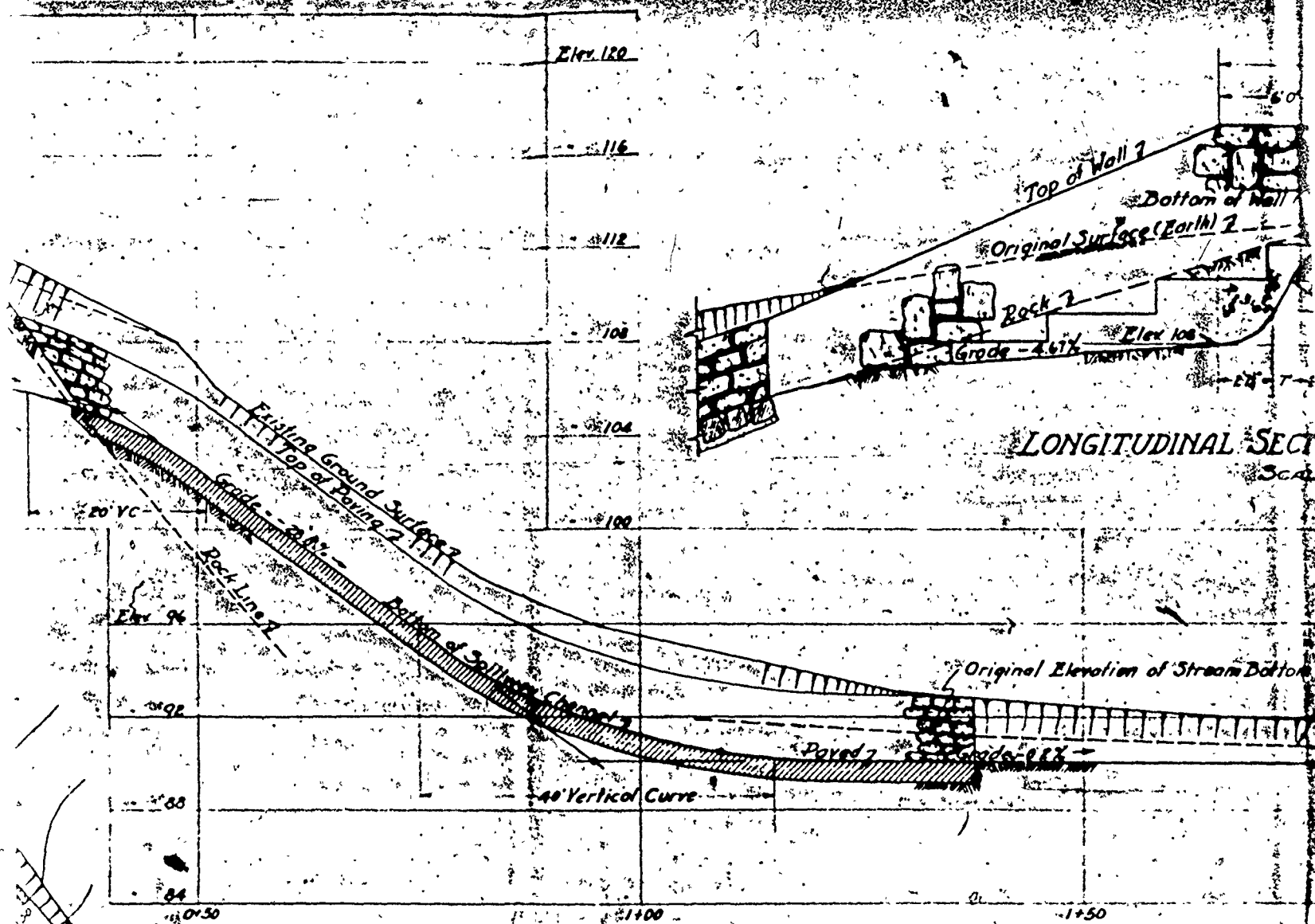
APPENDIX 5

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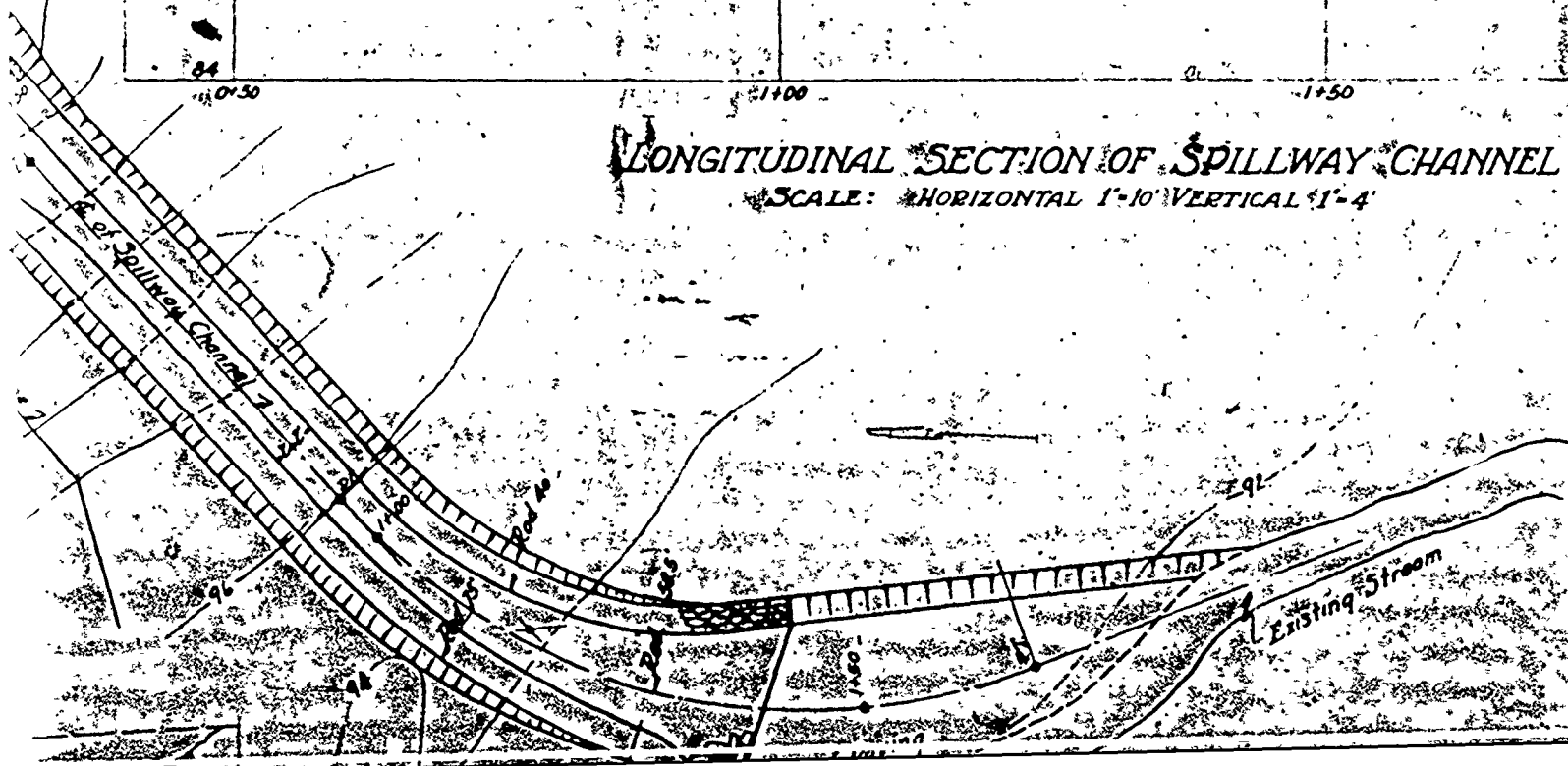
1. Chow, Ven Te, Open Channel Hydraulics, McGraw-Hill Book Company, New York, 1959.
2. King, H.W. and E.F. Brater, Handbook of Hydraulics, McGraw-Hill Book Company, New York, Fifth Edition 1963.
3. Schwab, G.O., R.K. Frevert, T.W. Edmister, and K.K. Barnes, Soil and Water Conservation Engineering, The Ferguson Foundation Agricultural Engineering Series, John Wiley and Sons, Inc., New York, 1966, 683 pp.
4. U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1) for Dam Safety Inspection Users Manual, Davis, California, September 1978.
5. United States Department of Interior, Bureau of Reclamation, Design of Small Dams, U.S. Government Printing Office, Washington, 1977, 816 pp.
6. U.S. Department of Interior, Geological Survey, 7.5-Minute Series (topographic) maps, scale 1:24000, Contour Interval 20 feet: Culvers Gap, N.J.-PA. (1954 photo-revised 1971).
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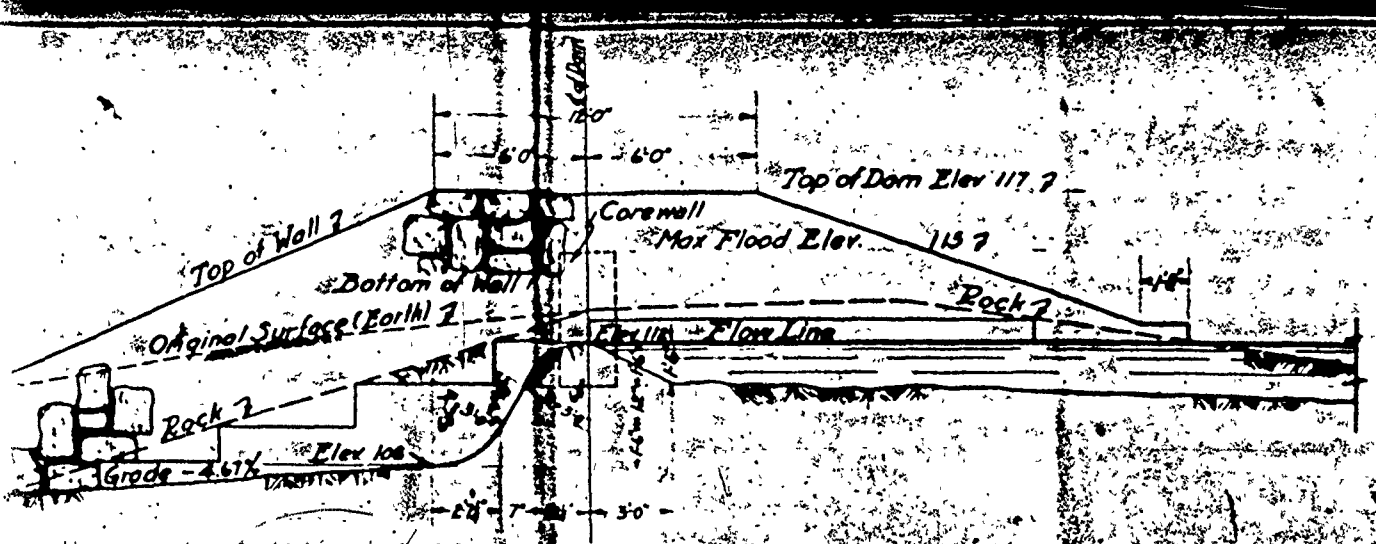


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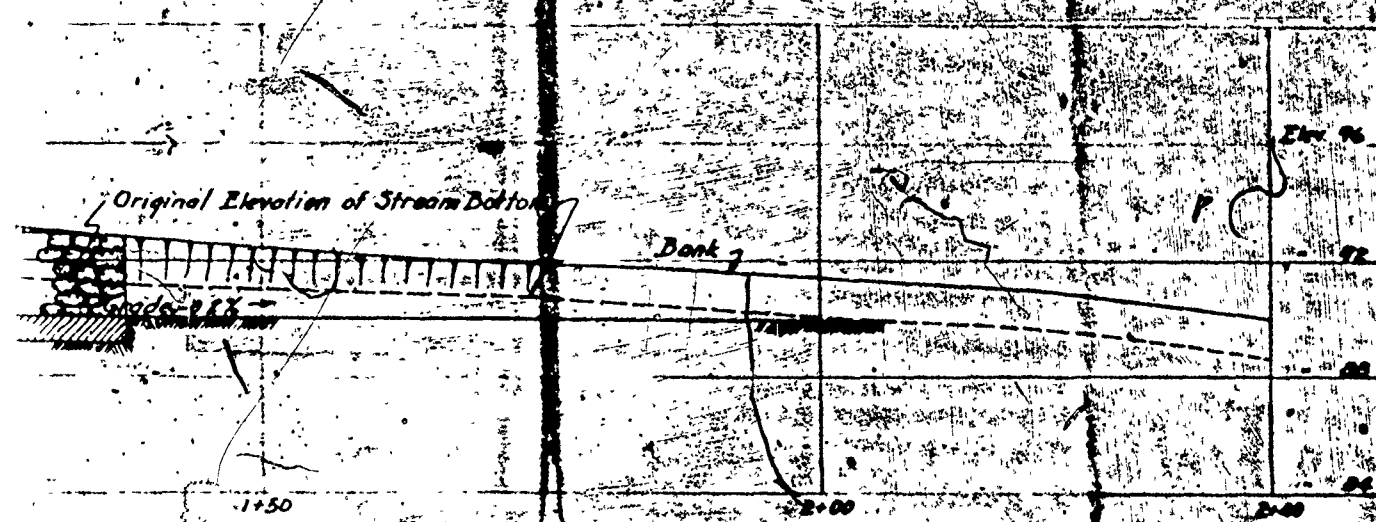


LONGITUDINAL SECTION OF SPILLWAY CHANNEL
 SCALE: HORIZONTAL 1"=10' VERTICAL 1"=4'

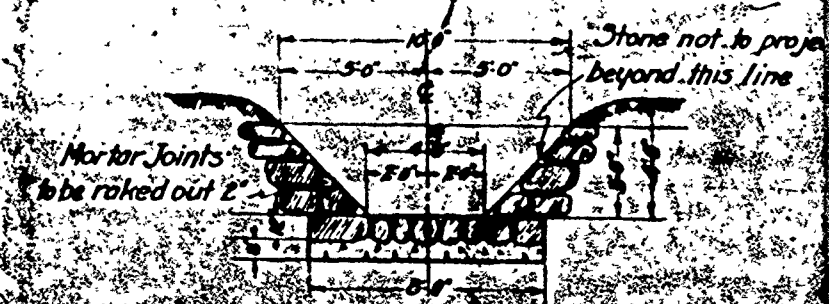
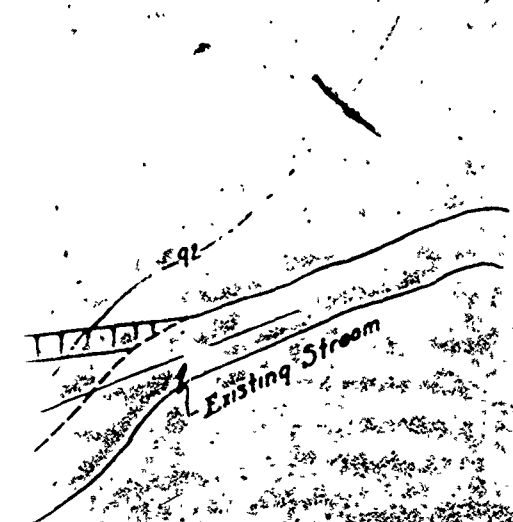




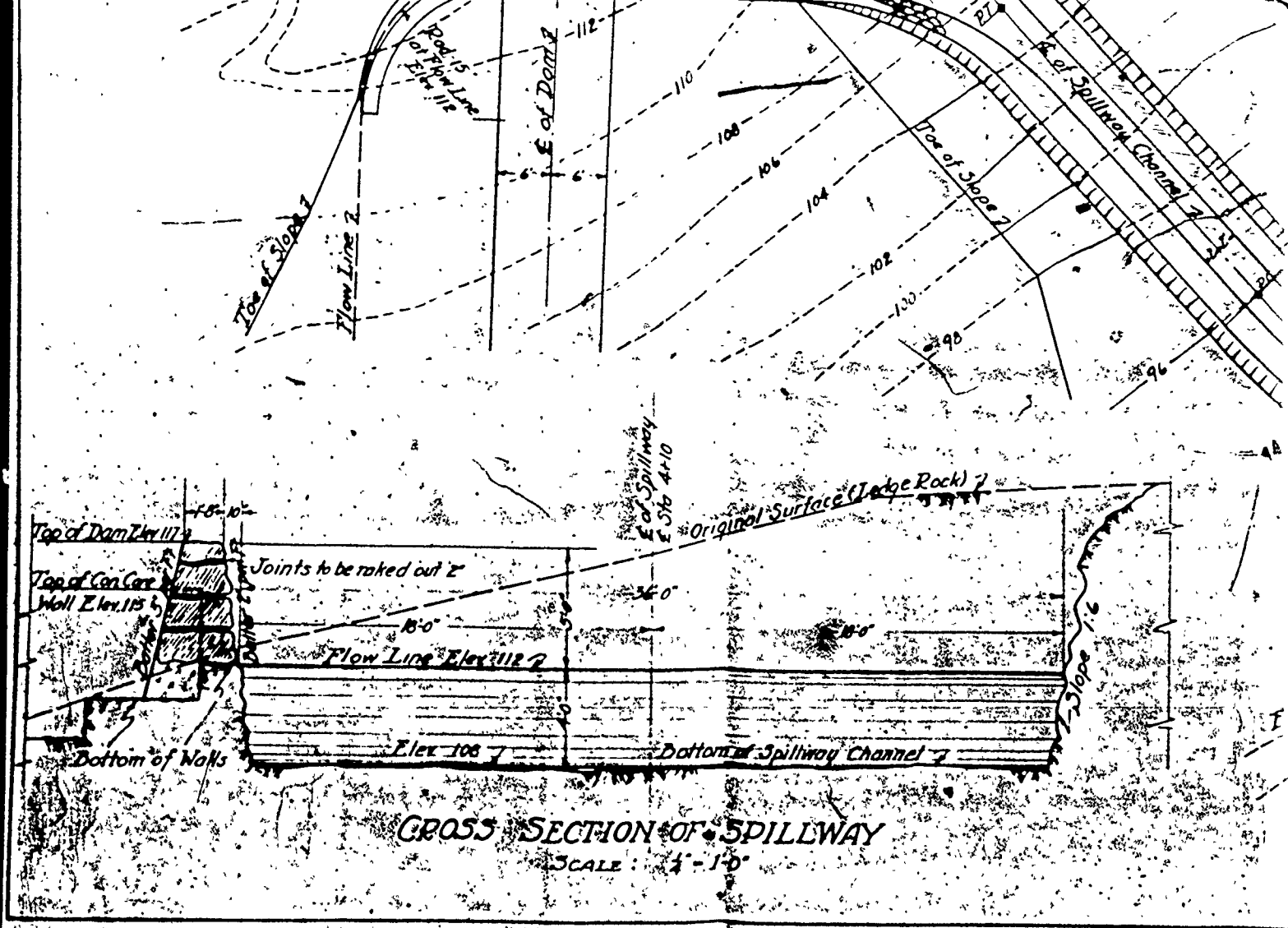
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Scale: 1" = 10'



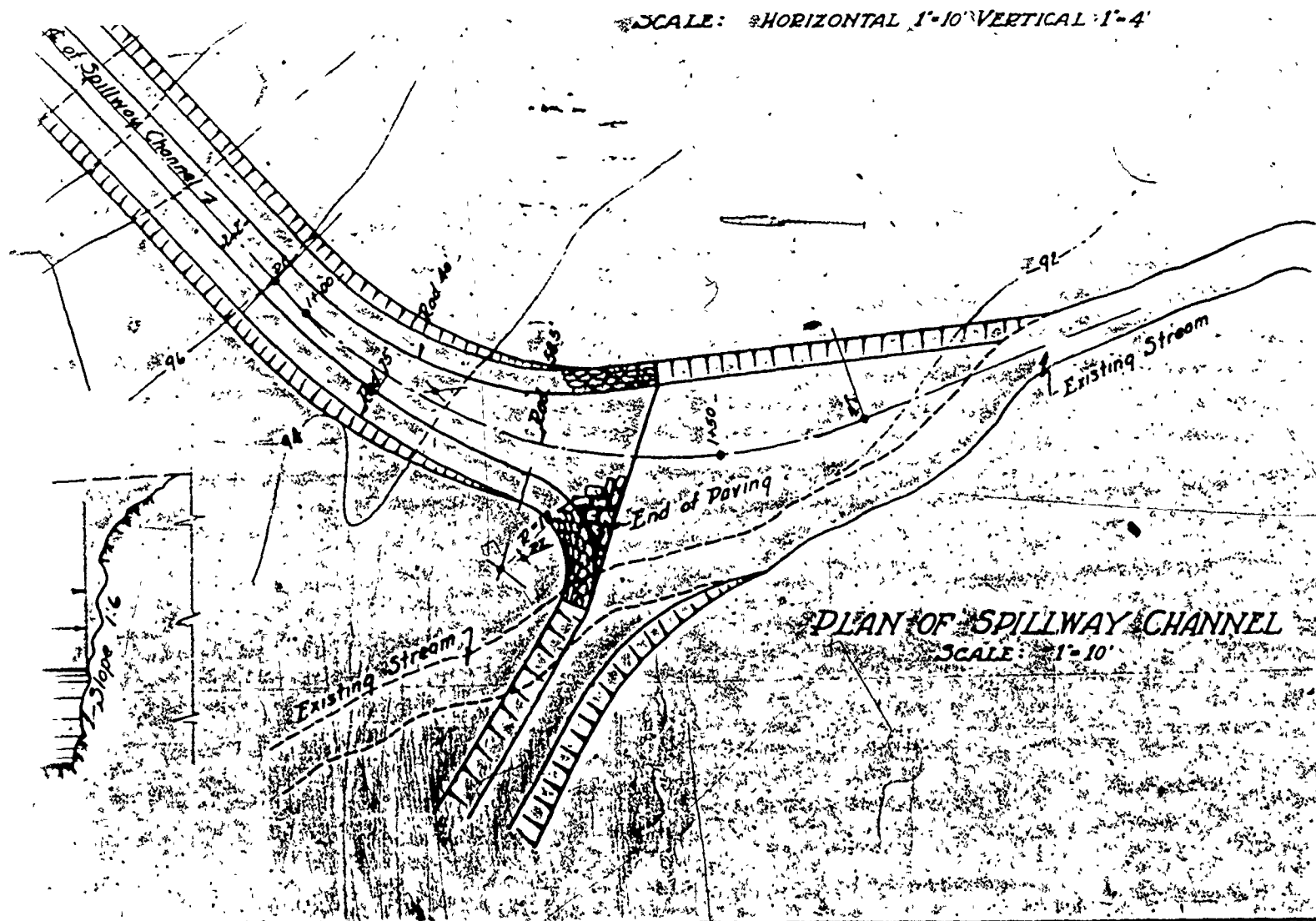
OF SPILLWAY CHANNEL
1" = 10' VERTICAL 1" = 4'



CROSS SECTION OF SPILLWAY CHANNEL
Scale: 1" = 10'



SCALE: HORIZONTAL 1"=10' VERTICAL 1"=4'



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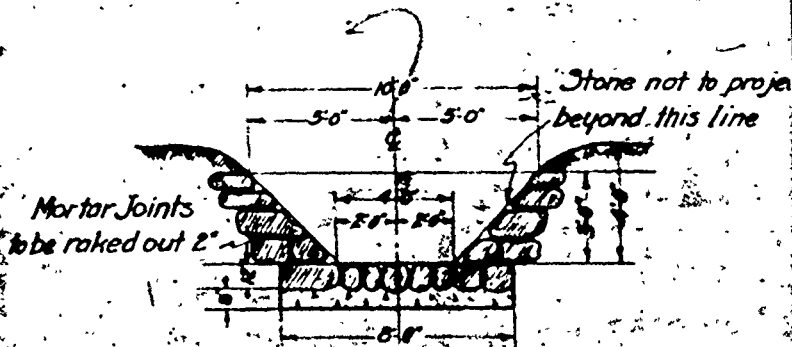
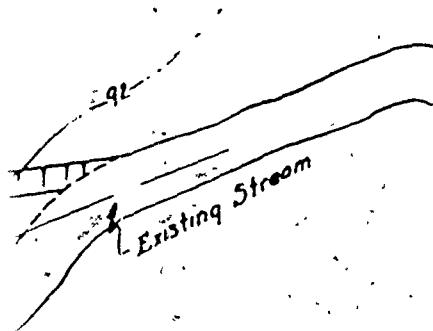
1+50

2+00

2+00

SPILLWAY CHANNEL

VERTICAL 1"=4'



CROSS SECTION OF SPILLWAY CHANNEL

SCALE: 1"=10'

APPROVED

SPILLWAY CHANNEL

SCALE: 1"=10'

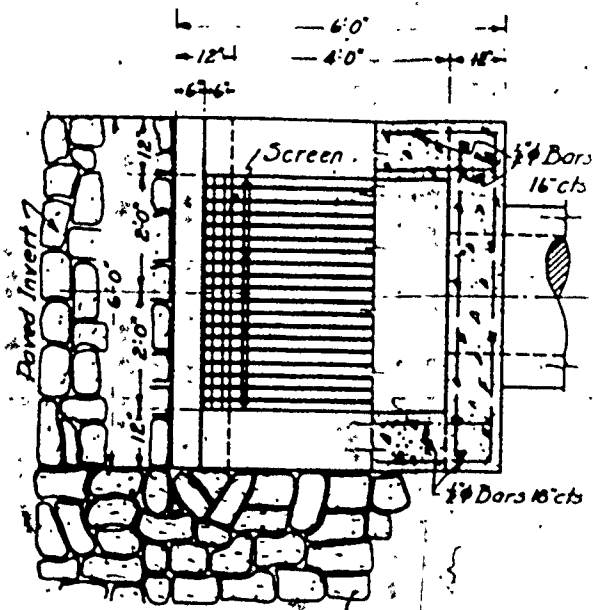
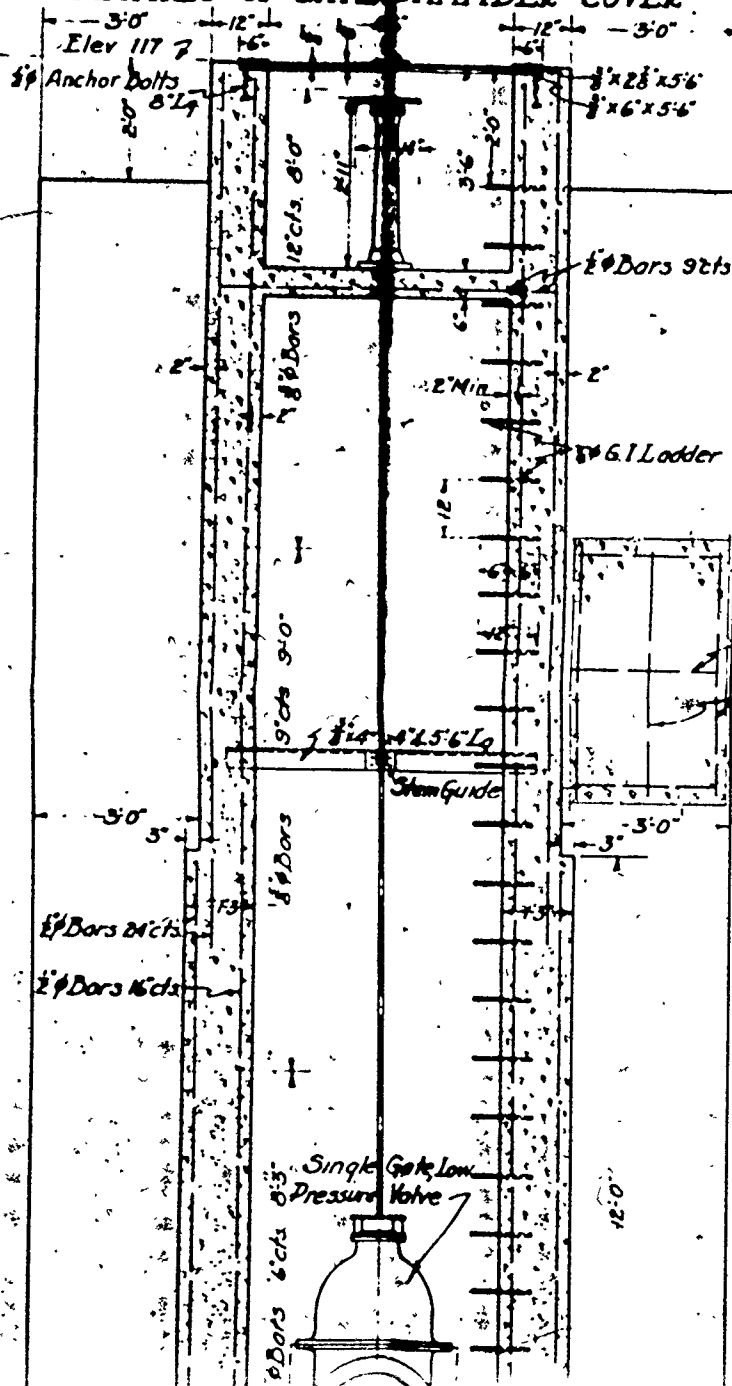
SHEET 4 OF 4

USDA CCC		STOKES STATE FOREST	INDEX MAP
SHAY LAKE PROJECT		CCC CAMP 351	APPROVED
PLAN & SECTIONS		OF	DATE 5-2-35
SPILLWAY CHANNEL			APPROVED
DATE MAY 1935			DATE 5-2-35

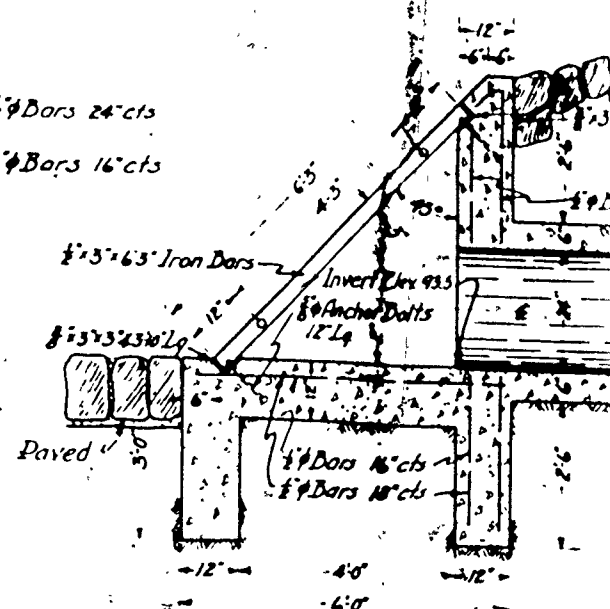
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DETAILS OF GATE CHAMBER COVER

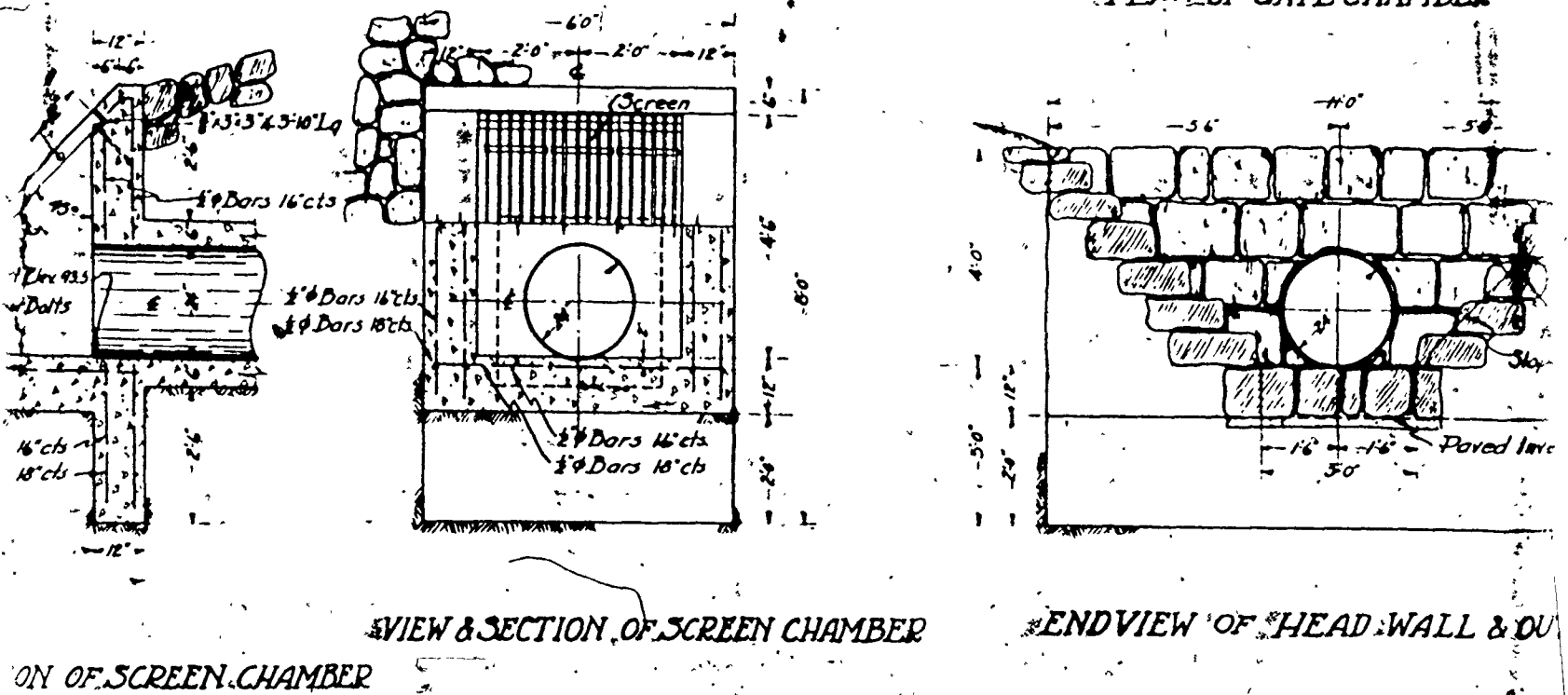
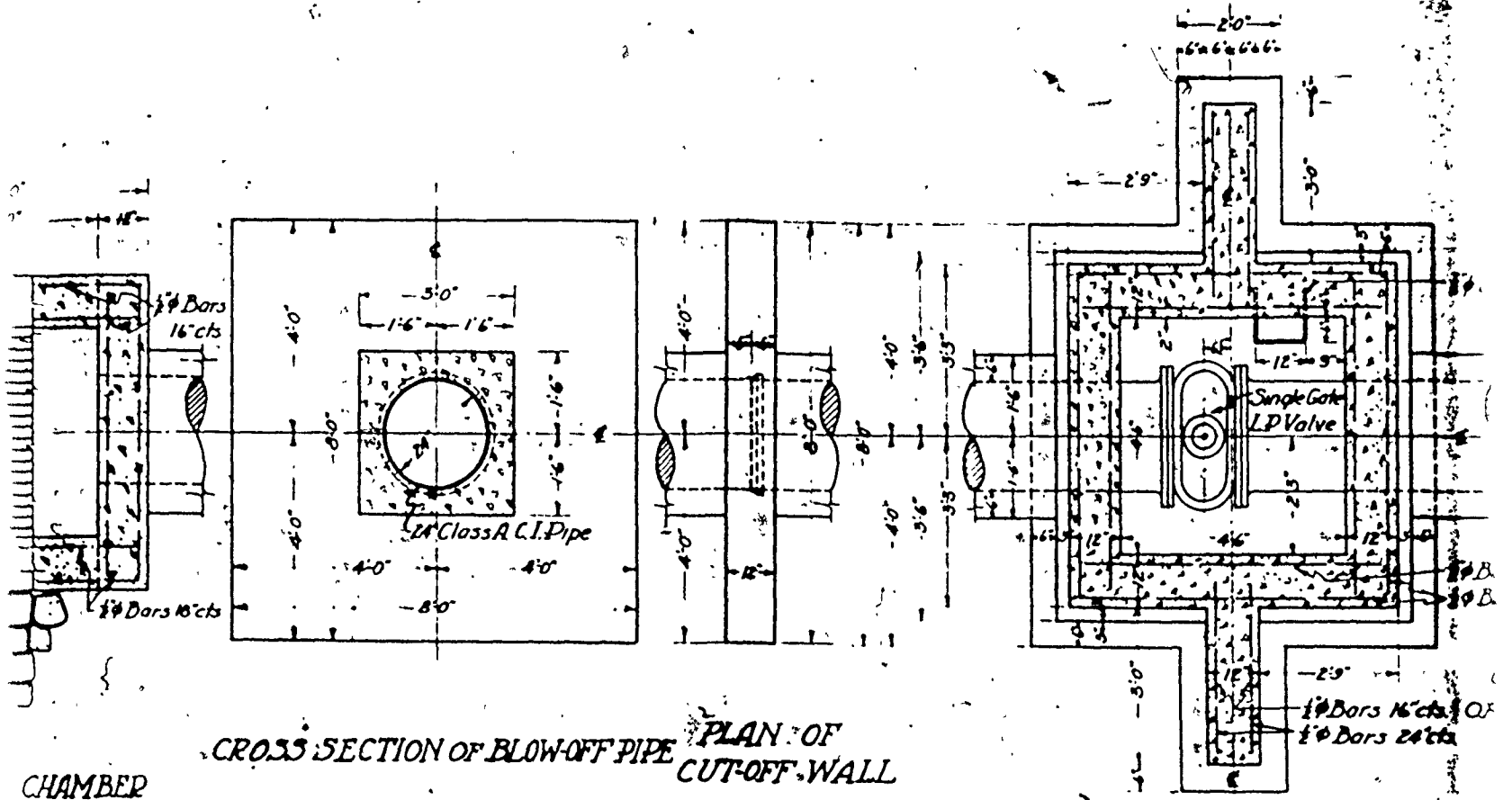


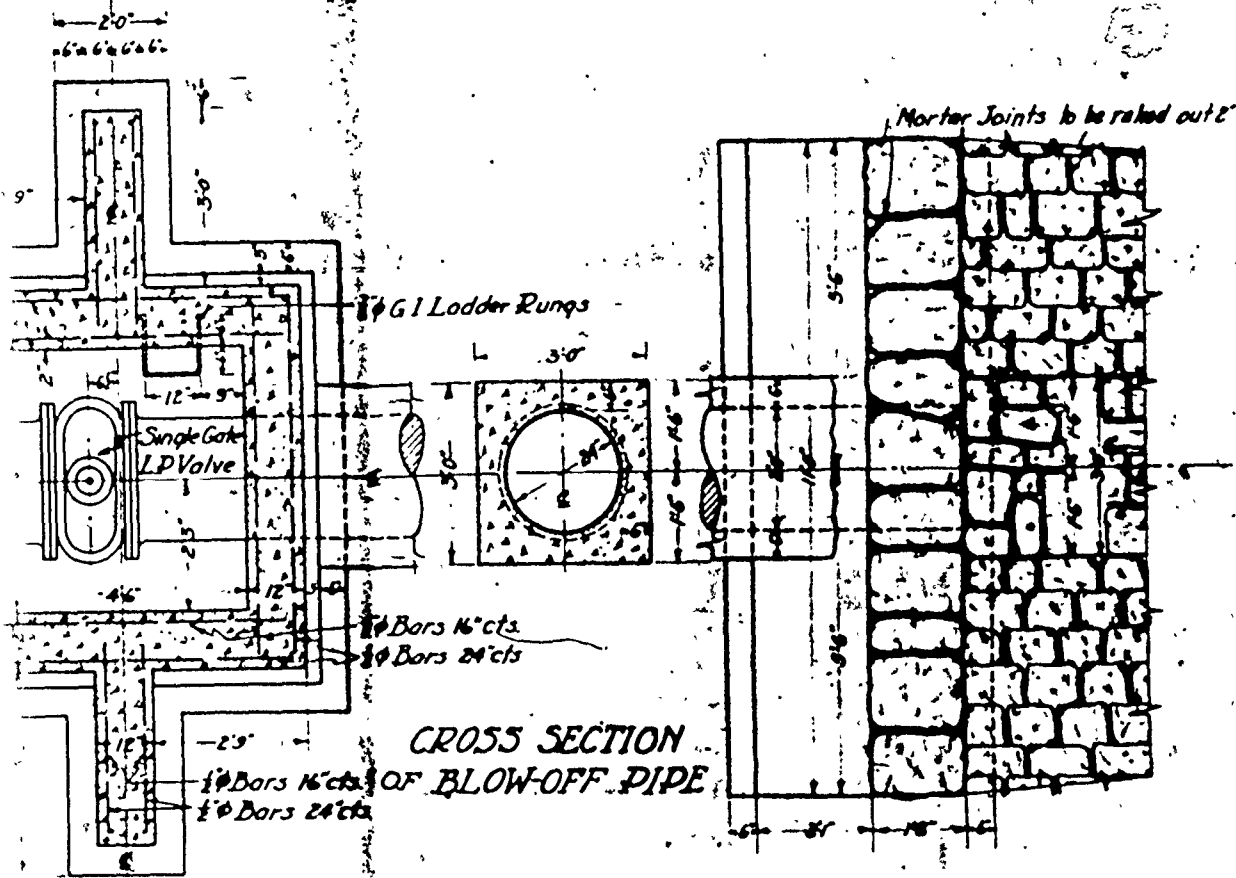
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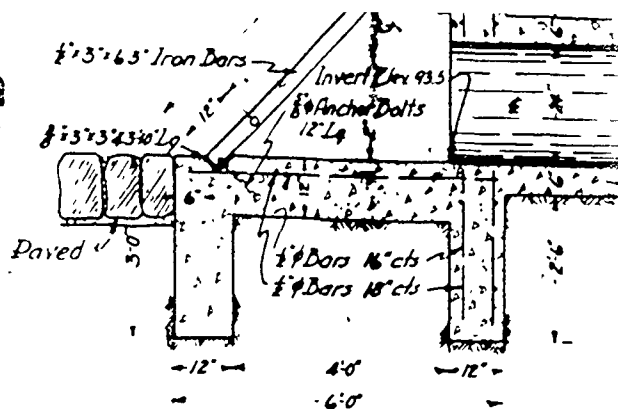
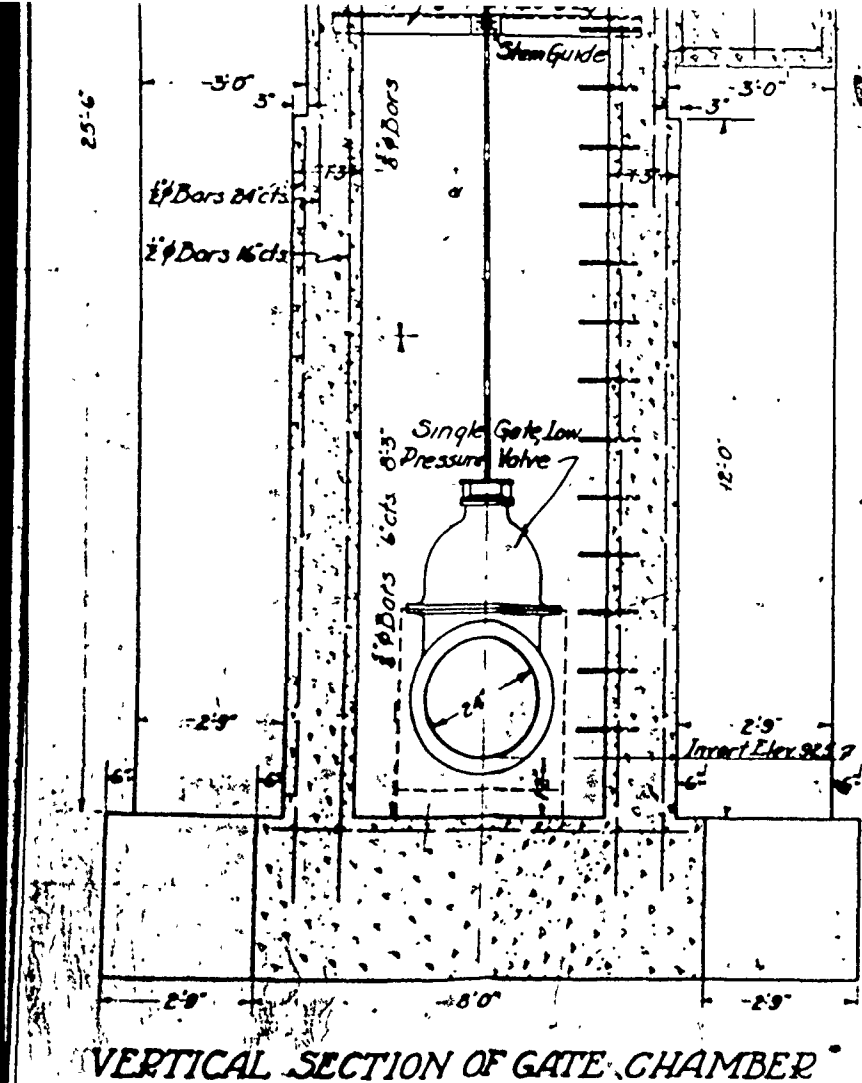


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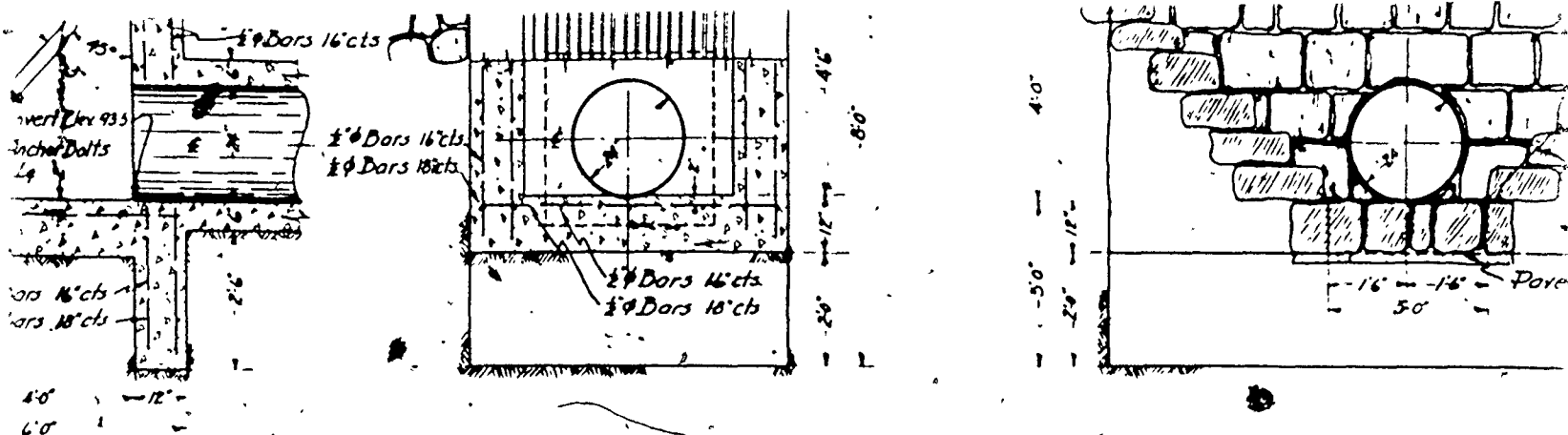
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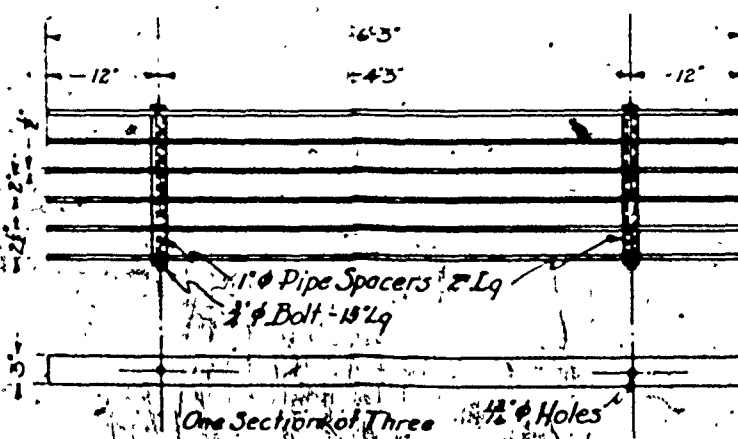
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VIEW & SECTION OF SCREEN CHAMBER

ENDVIEW OF HEAD WALL

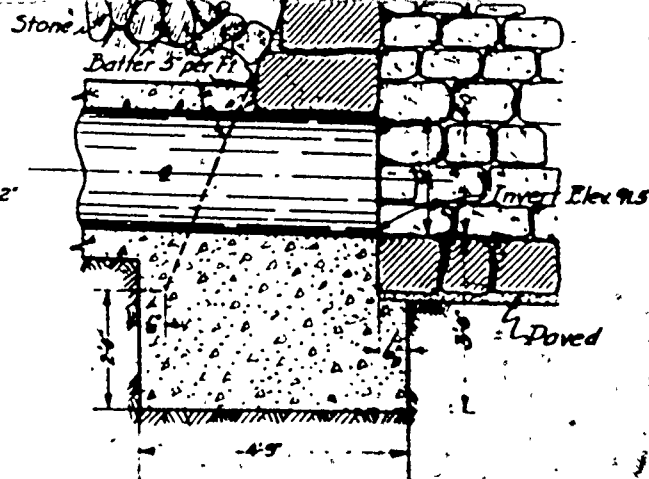
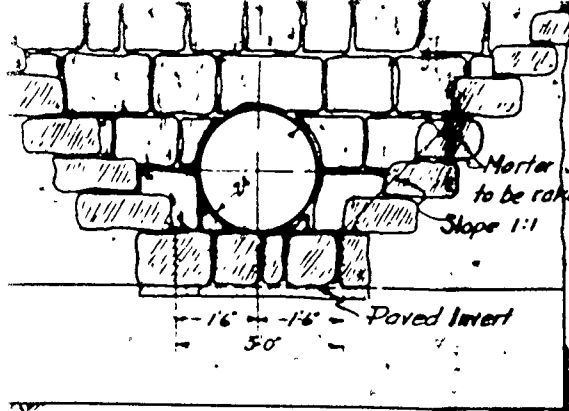
SECTION OF SCREEN CHAMBER



DETAILS OF TRASH SCREEN

SCALE 1" = 1'-0"

5



VIEW OF HEAD WALL & OUTLET

CROSS SECTION OF HEAD WALL & OUTLET

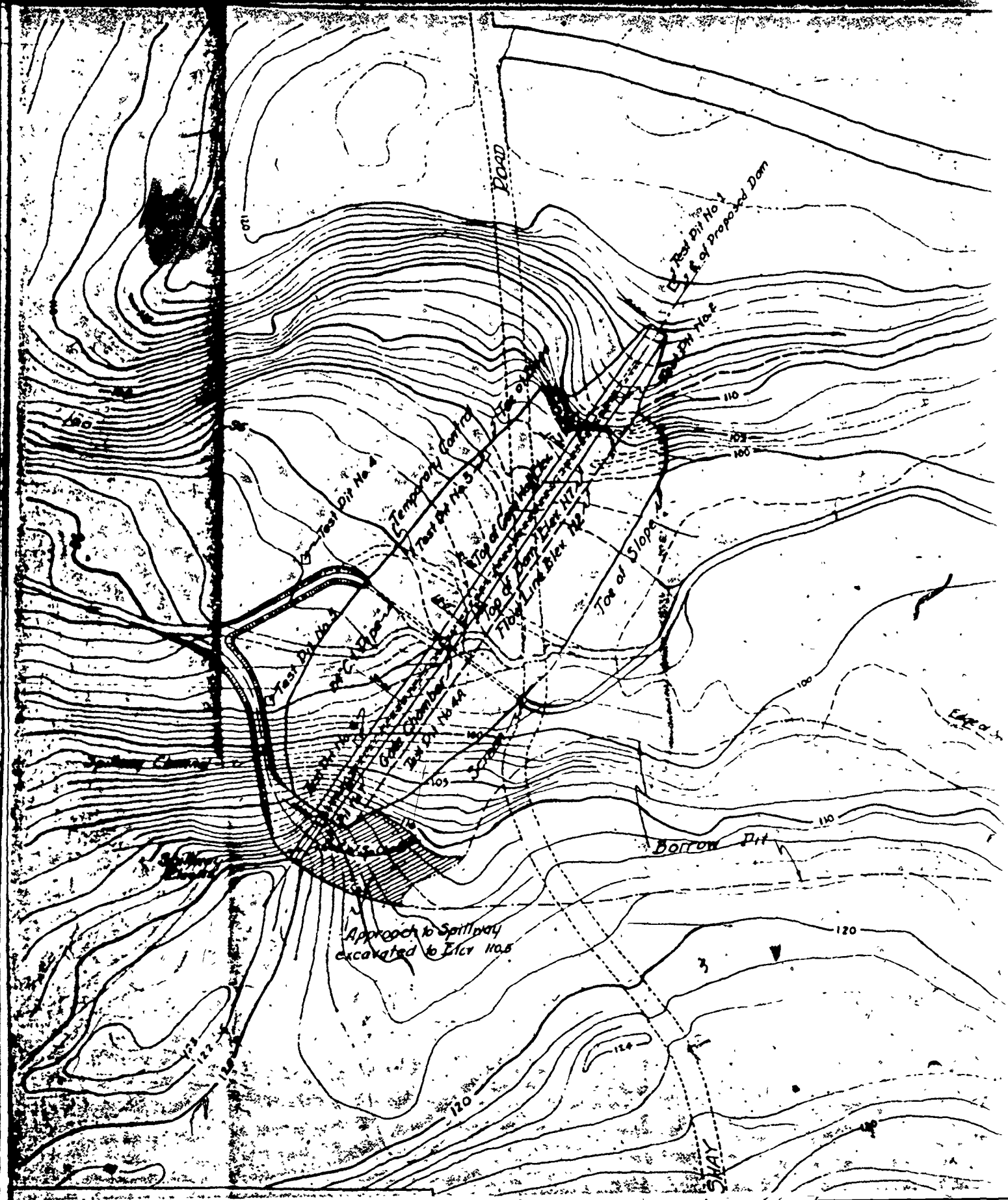
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SHEET 3 OF 4

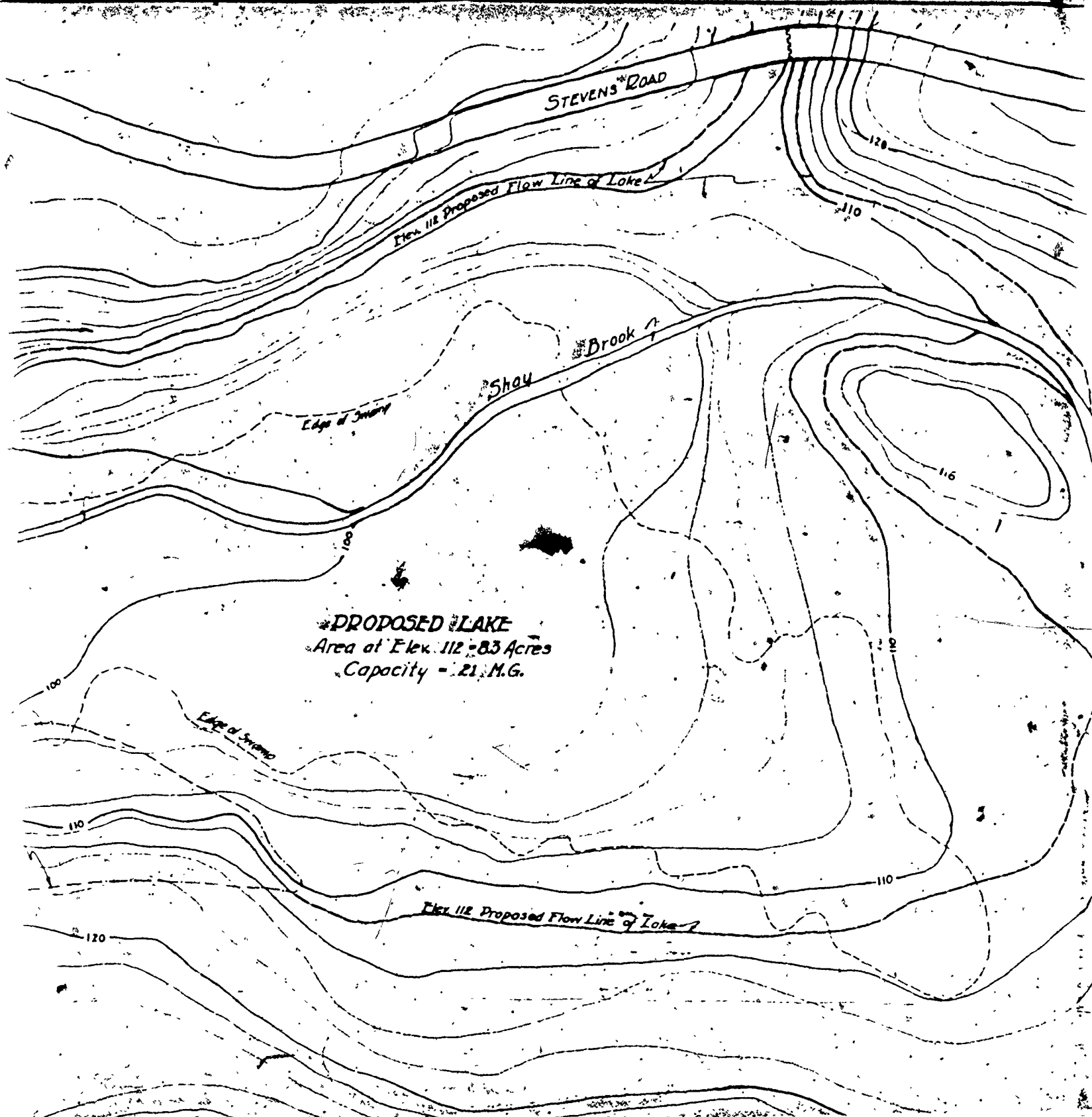
STATE OF NEW JERSEY DEPARTMENT OF CONSERVATION & DEVELOPMENT USDA CCC		
SCALE 1" = 10'	STOKES STATE FOREST	INDEX NO.
DESIGNED BY STR	SHAY LAKE PROJECT	APPROVED BY J. J. [Signature]
DATE MAY 1930	CCC CAMP S-51	DATE MAY 1930
DESIGNED BY STR	DETAILS OF BLOW-OFF PIPE	DATE MAY 1930
DATE MAY 1930		DATE MAY 1930

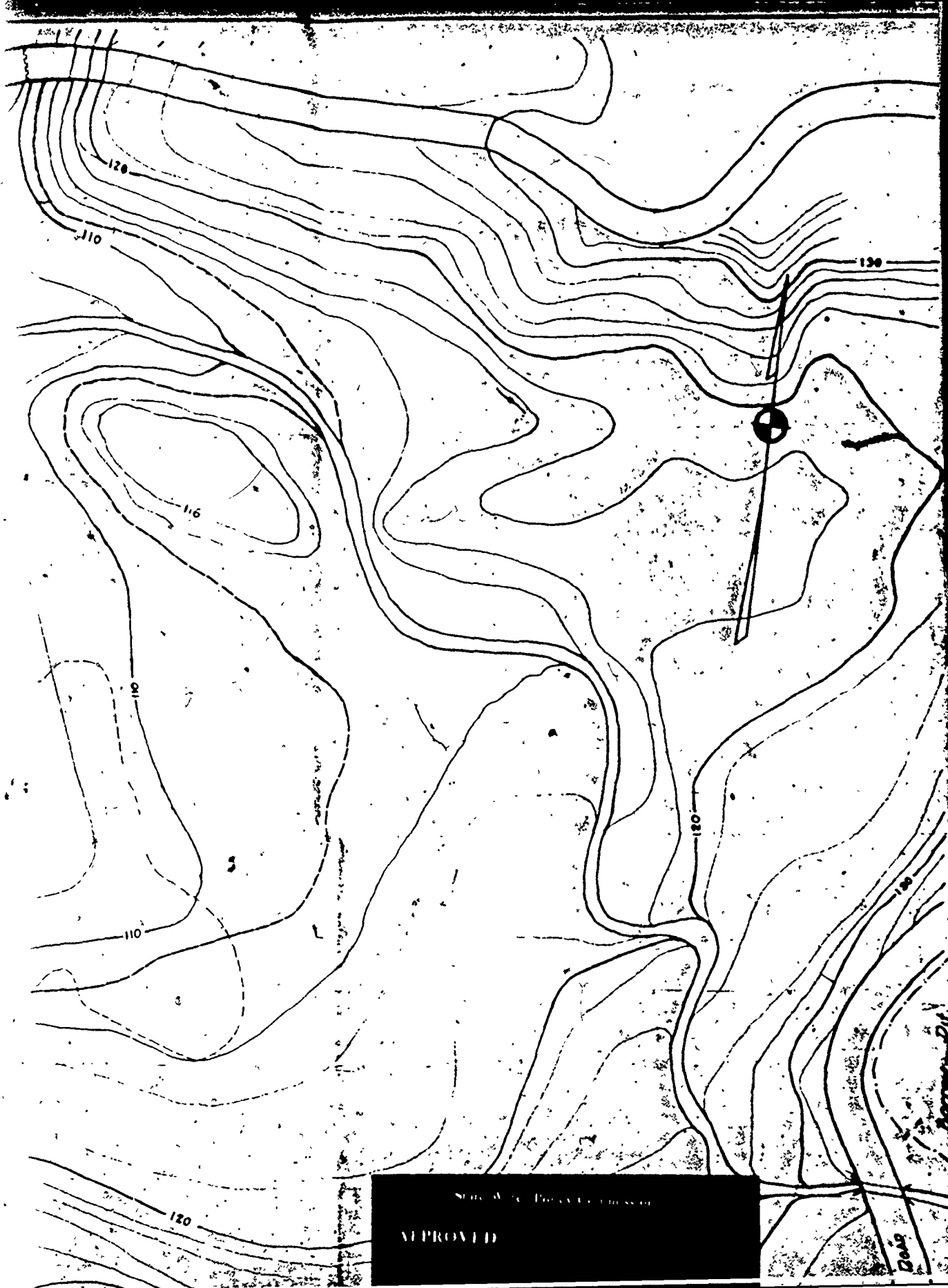
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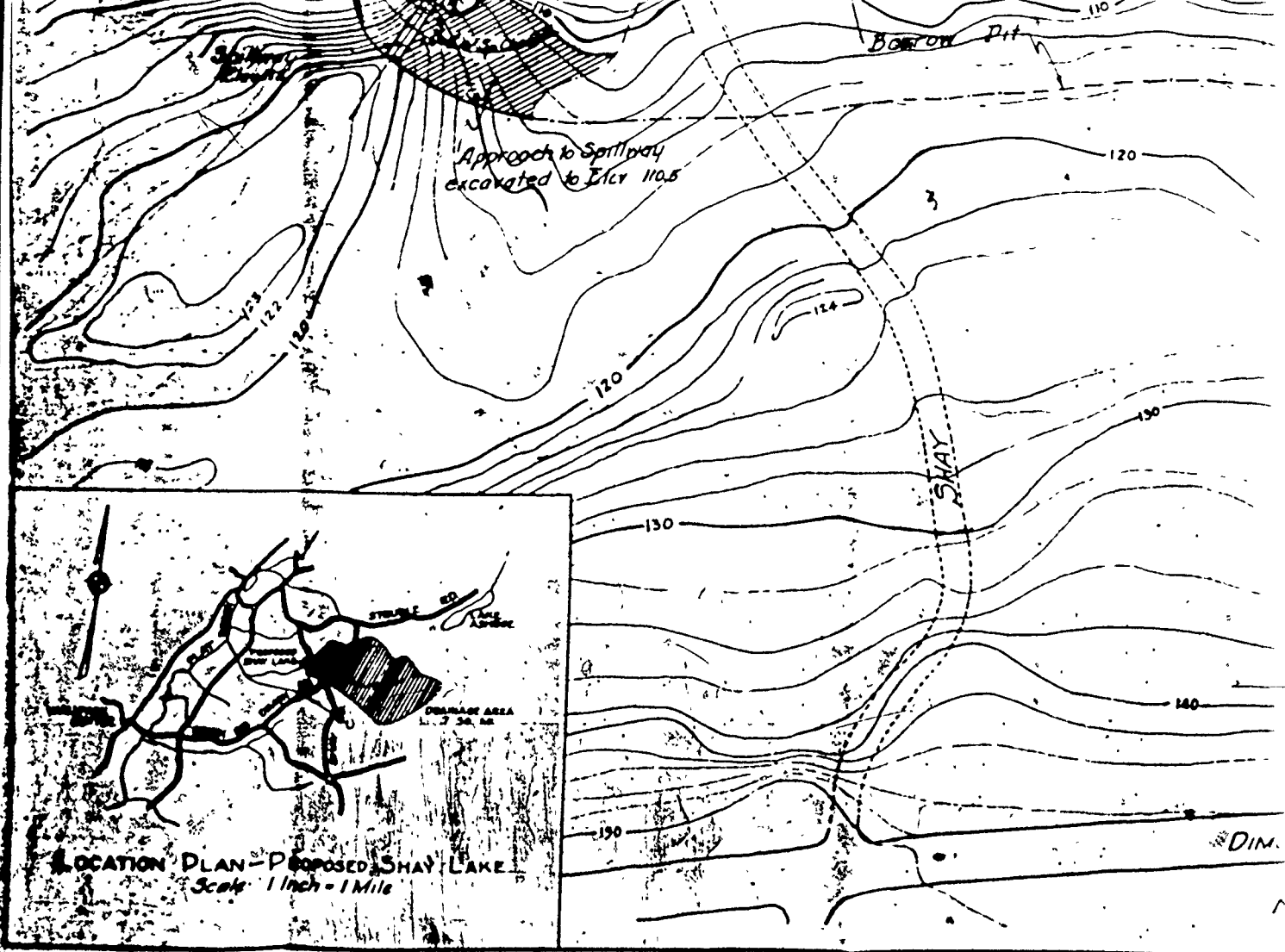


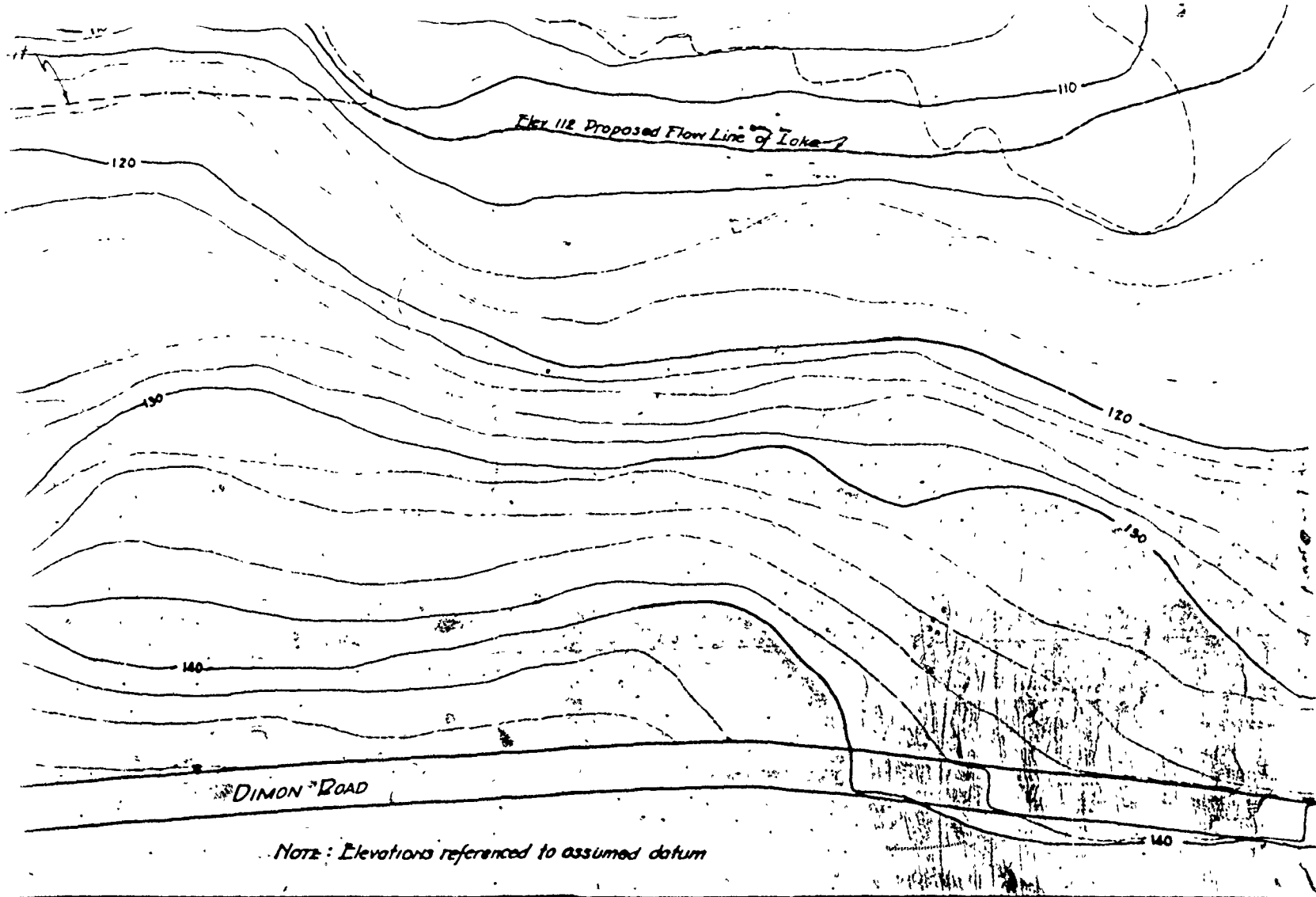
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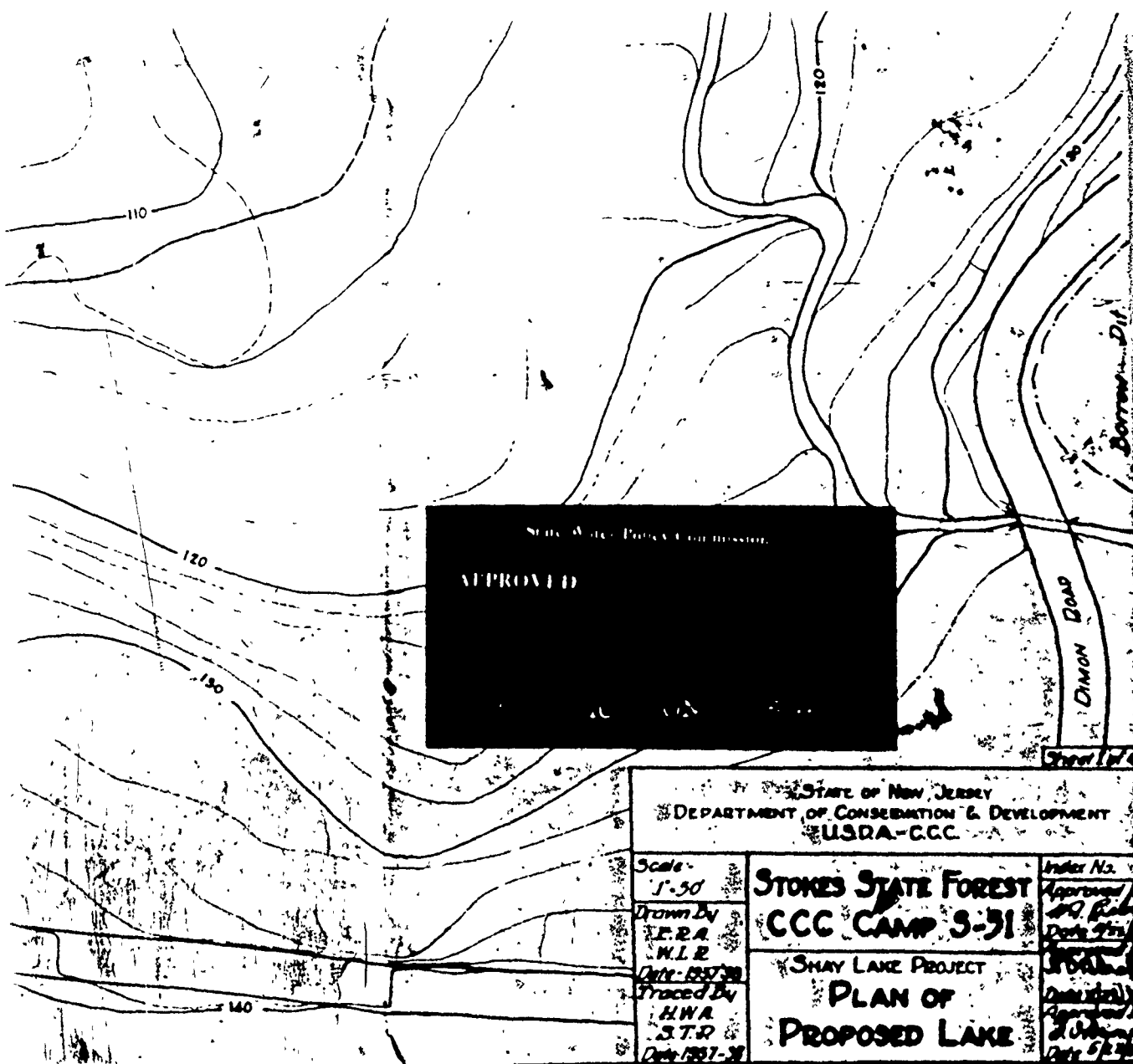


STUDY AREA PROPOSED CROSSING
 APPROVED



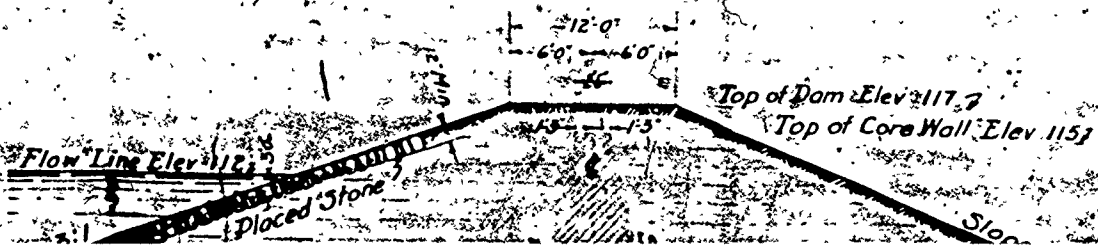
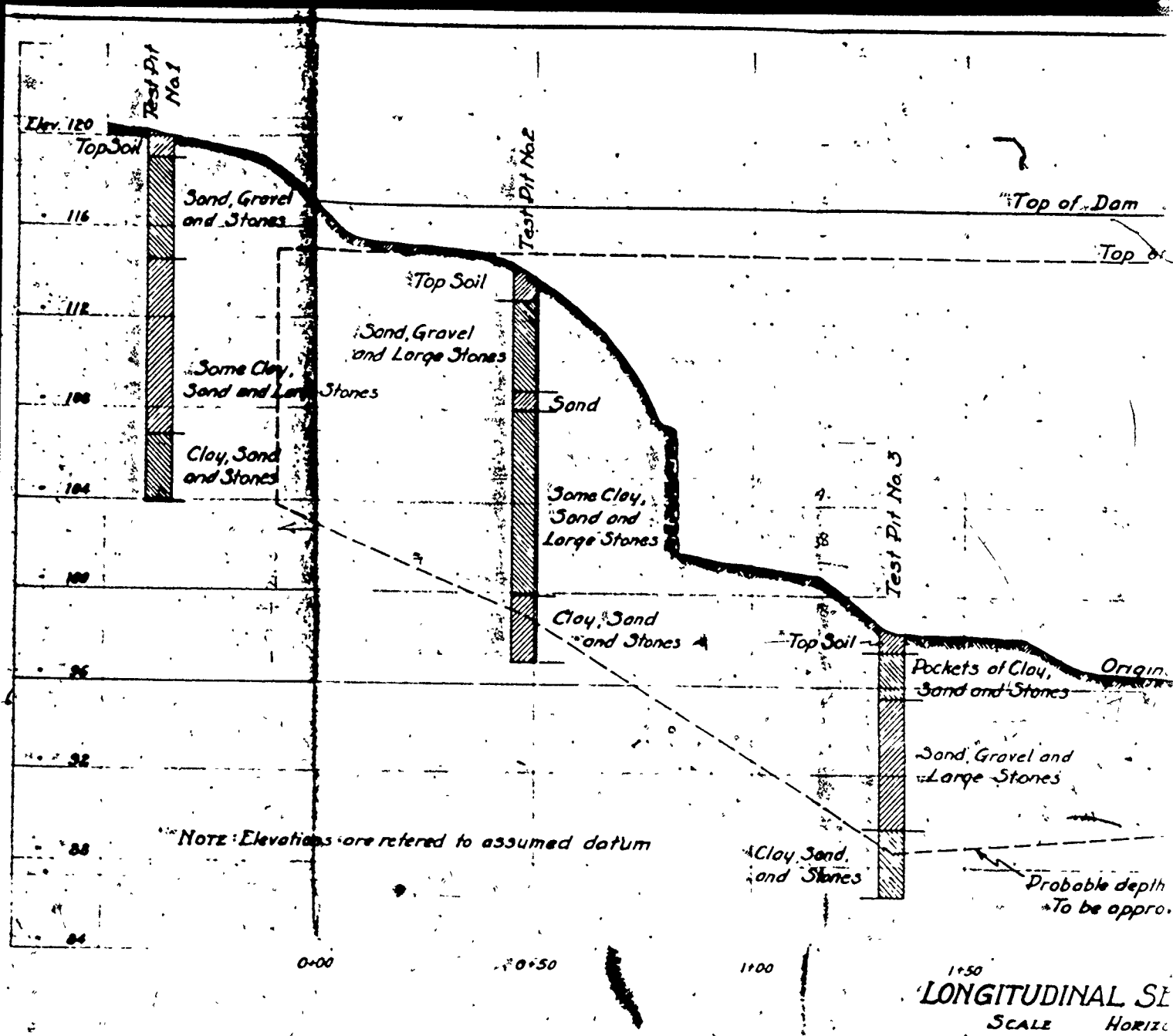


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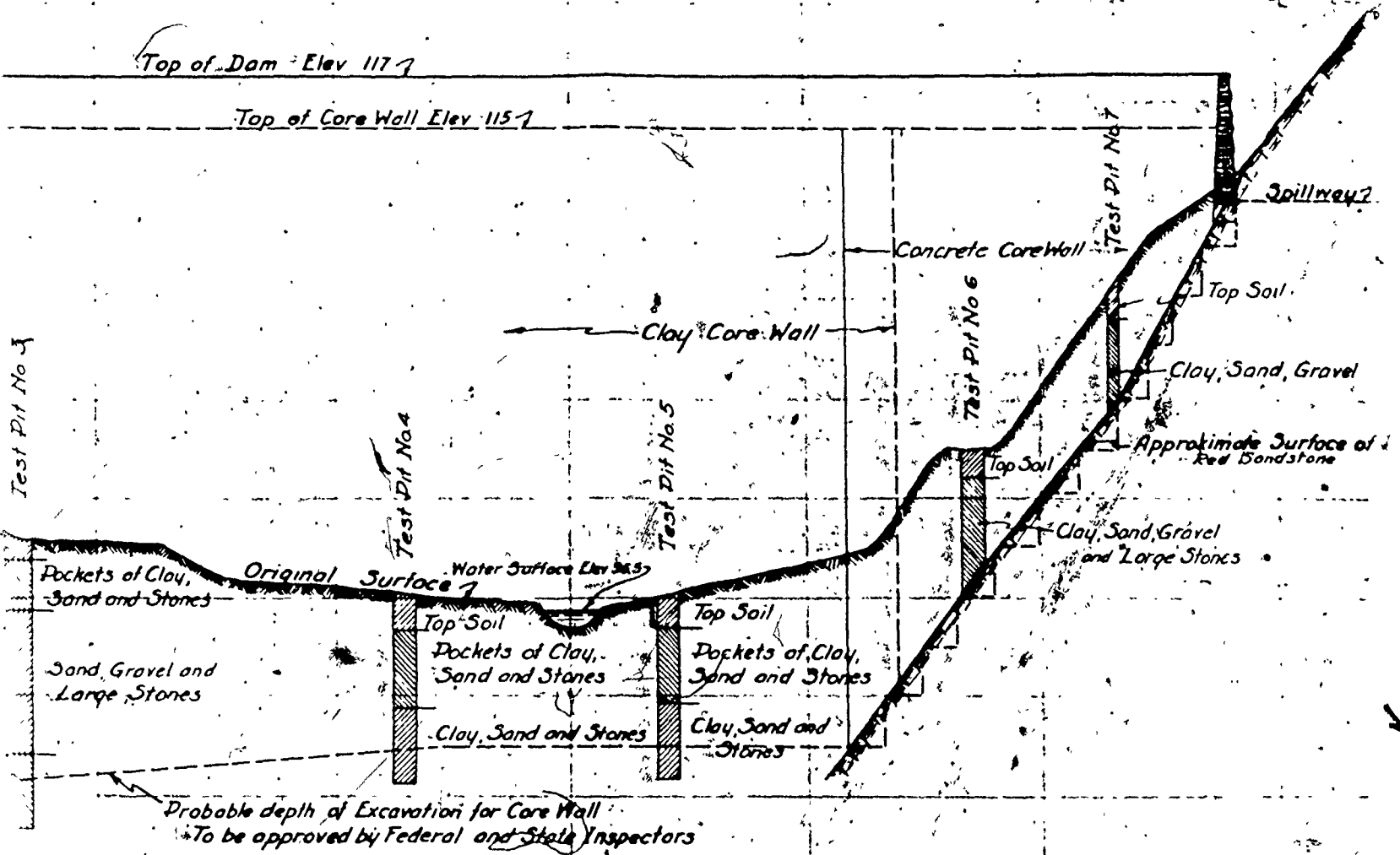


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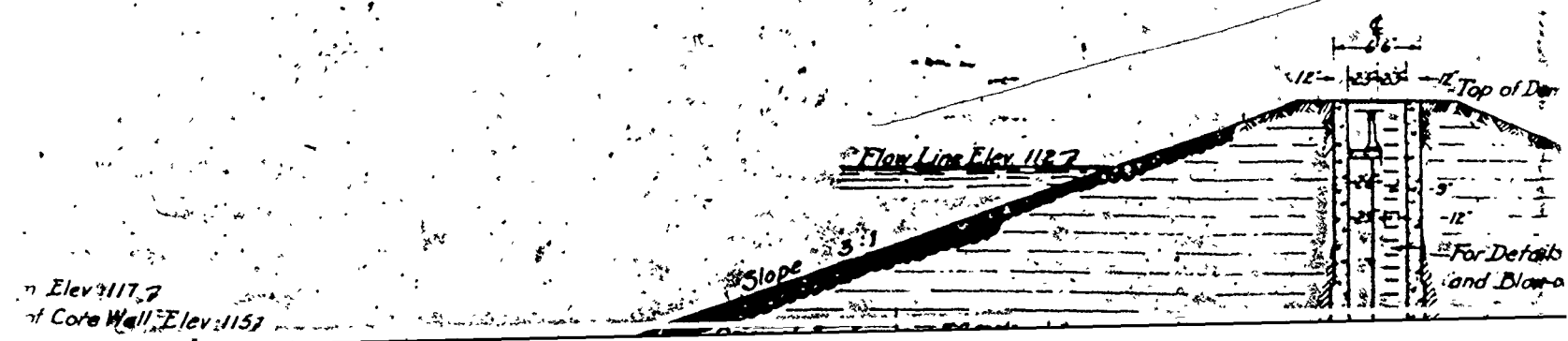
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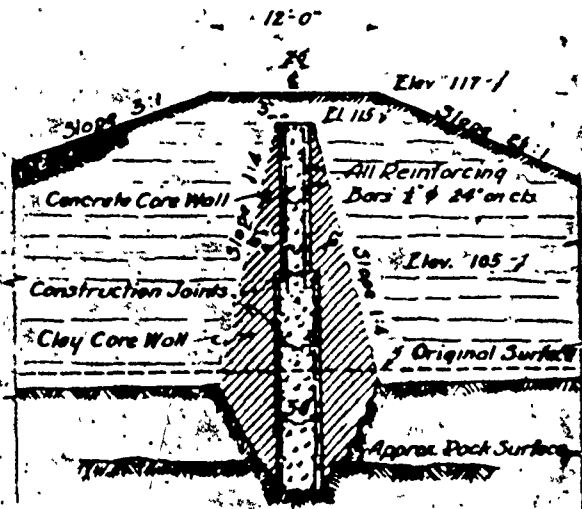
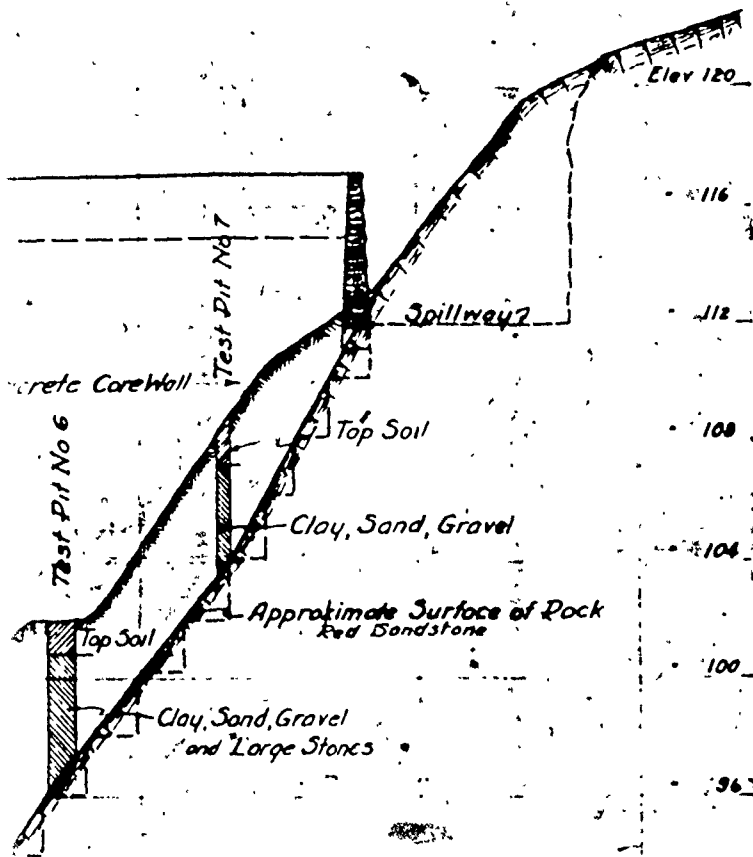


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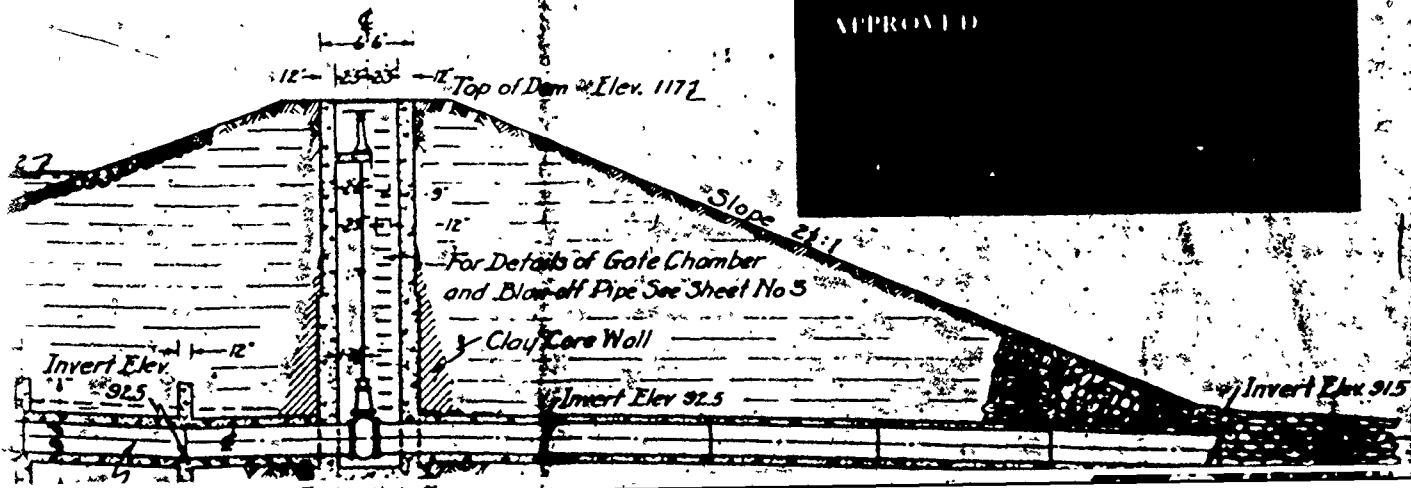
11.50 2.00 2.50 3.00 3.50 4.00
LONGITUDINAL SECTION OF PROPOSED DAM
 SCALE HORIZONTAL 1"=20' VERTICAL 1"=4'

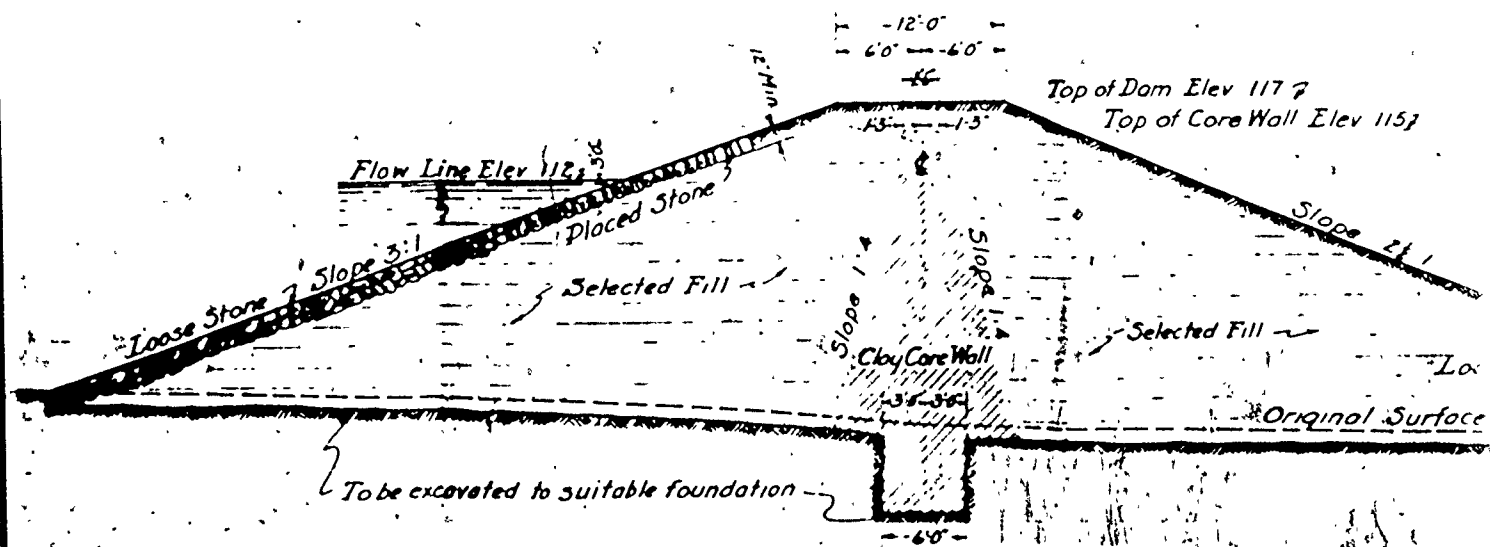




CROSS SECTION OF DAM
THRU CONCRETE CORE WALL
Scale - 8'-1'-0"

APPROVED

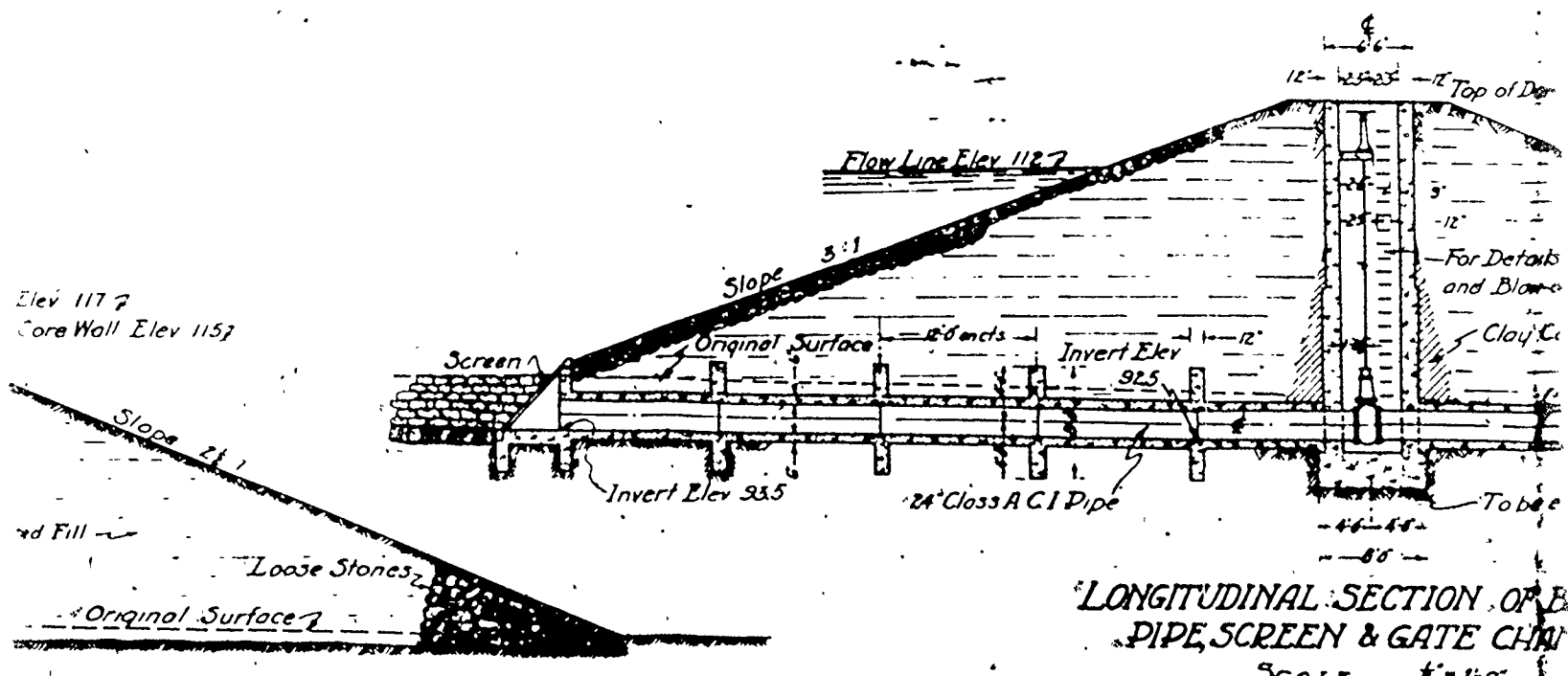




CROSS SECTION OF PROPOSED DAM

SCALE - 1"=1'-0"

4



LONGITUDINAL SECTION OF PIPE, SCREEN & GATE CHAMBER
SCALE 1" = 1'-0"

3M

5 1

